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THE PRESIDENT'S PAGE

It will probably not be news to many Wilson Club members that your President has a considerable degree of enthusiasm in matters pertaining to the Southern Appalachian Highlands. It is to me, therefore, a source of great gratification that the Club will soon be meeting, for the second time in three years, in this region of endless fascinations. Those who know the Great Smoky Mountains will need no urging to attend; those who will be coming for the first time have a rewarding experience in store.

Rich in scenic, historic, and biotic values, the Great Smokies are a fitting climax to the Appalachian system. Upon thousands of acres of mountain slopes the original forest is, perhaps, the finest deciduous stand in any mid-latitude area of the earth's surface. At the highest summits is the extreme southeastern outpost of boreal spruce-fir. In the foothills Yellow-throated Warblers nest, and Chuck-will's-widows call at dusk. Only a few miles away on the crests are Olive-sided Flycatchers, Brown Creepers, Golden-crowned Kinglets, and Winter Wrens.

For those bird students who look also at other vertebrates, the region is rewarding. The Smokies can claim a longer list of lungless salamanders than any other region, and the handsome red-cheeked Jordan's Salamander has been found nowhere else. Bears are abundant, and may be seen along the trails or at picnic and camping areas. Native Brook Trout and other cold-water fishes are found in the tumbling mountain streams.

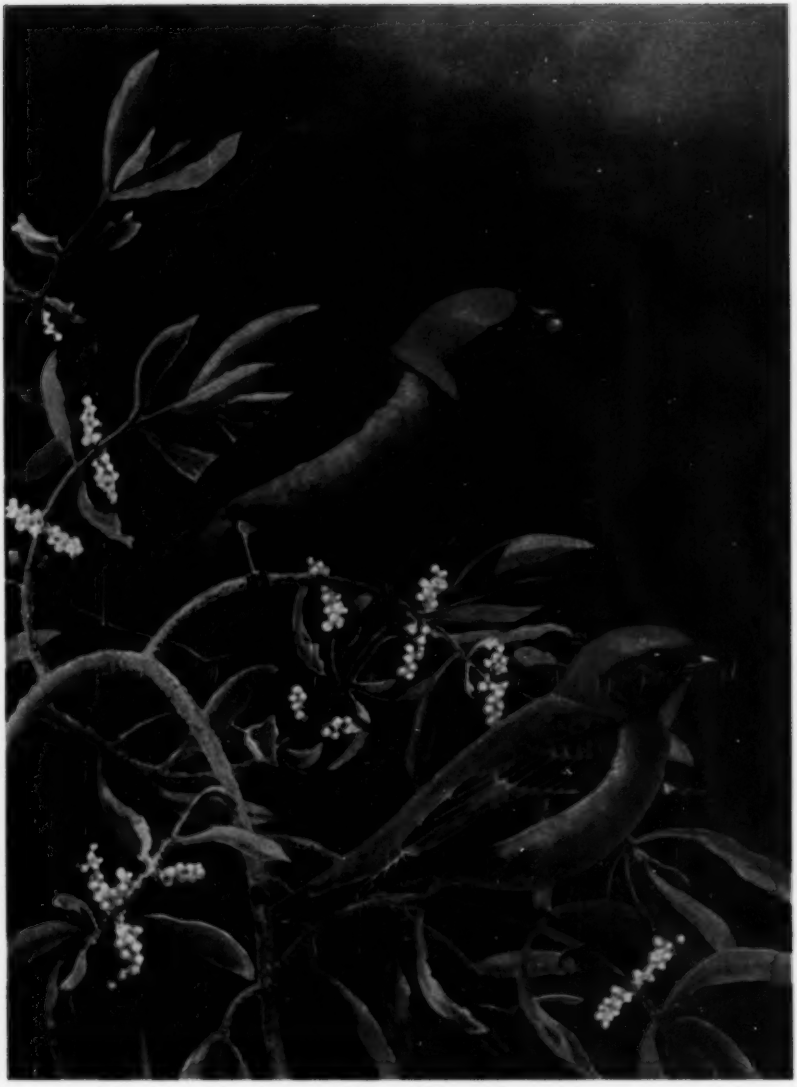
From the breakfast table in Gatlinburg the visitor may look up an unbroken slope to the myrtle-clad summit of Mount Leconte five thousand feet above. Cars may be driven to within one-half mile of the top of Clingman's Dome, highest point in the range. Two miles beyond this parking area is Andrews Bald, one of the grassy openings whose presence in the Southern Highlands has aroused great ecological interest and controversy. The Appalachian Trail follows the highest ridge, and along it hikers may visit many scenic areas.

Late April is a season of blossoms in the mountains. On lower slopes spring will be well advanced, and its succession may be traced in reverse as one climbs. We shall be too early for the rhododendrons, but others of the heaths will be opening. Redbud, serviceberry, flowering dogwood, silverbell, and other showy plants should be blooming at some level on the mountains.

By no means least among the region's attractions are the people and their ways of living. For two centuries they were isolated, and, with low incomes, had to depend upon home crafts and arts. Some of these crafts persist. Handmade articles, useful and beautiful, are marketed in Gatlinburg, and there are still a few producing handicraft artists. On the eastern slope is the Cherokee Indian reservation, where traditional basketry is still a tribal craft.

This will be the first Wilson Club meeting in one of our national parks. Here we may see at work the program of preserving our forests, waters, wildlife, and other wilderness values. We are privileged to share in this great heritage.

MAURICE BROOKS



BLUE-HOODED EUPHONIAS
(Tanagra elegantissima)

A pair (male above) eating mistletoe berries. From a painting in water-color based on field-sketches made in the states of Hidalgo and Michoacán, México, in the early spring of 1949.

DISPERSAL OF MISTLETOE BY BIRDS

BY GEORGE MIKSCH SUTTON

THAT birds are an important agent in the dissemination of mistletoe (*Phoradendron*, *Loranthus*, and allied genera) has long been common knowledge; but the more I have seen of birds and mistletoe, and the more I have read concerning the relationships between the two, the more convinced I have become that the 'common knowledge' referred to is only half-knowledge at best. Weaver and Clements, in their standard work, "Plant Ecology" (Second Edition, 1938), sum up this half-knowledge thus: "Mistletoe, a parasite on trees, often of considerable economic importance, is disseminated by birds. After eating the enveloping fleshy rind, the slimy seeds which frequently stick to their bills may be wiped off upon the branches where they are perched and, hence, in places suitable for germination" (p. 128).

Some birds may, indeed, wipe slimy mistletoe seeds from their bills, but birds which I have watched while they were eating mistletoe berries certainly have not removed the enveloping fleshy rind; they have swallowed the berries whole. They may, I believe, occasionally regurgitate a berry and wipe it from the bill, but I have never observed this. Such regurgitated berries probably would not be very sticky. I am convinced that comparatively little dissemination of mistletoe is accomplished through bill-wiping; that most of it is, indeed, accomplished through defecation. What is more, there is a remarkable correlation between this whole process of dissemination-through-defecation and the digestive apparatus of at least some of the bird-disseminators. Serventy and Whittell, in "A Handbook to the Birds of Western Australia," have this to say about the Mistletoe-bird (*Dicaeum hirundinaceum*): "This bird, as its name implies, is intimately associated with mistletoe (*Loranthus*) and is its most active disseminator. As an adaptation to this specialized diet the muscular portion of the stomach . . . has virtually disappeared and the alimentary canal (including the oesophagus, glandular portion of the stomach and the intestine) appears superficially to be an even duct, with no enlargements" (p. 309).

Now for a brief discussion of my first Cedar Waxwing (*Bombycilla cedrorum*) specimen. I shot the bird near Fort Worth, Texas, many years ago. It was one of a large flock perched in the very top of an oak. As I picked it up I was greatly impressed with its sleek plumage and soft colors. Since I had, with my own eyes, seen it and its fellows gobbling mistletoe berries only a few minutes before, I was not surprised when two whole mistletoe berries dropped from its mouth. On skinning it later, however, I *was* surprised when I encountered more mistletoe berries—indeed what appeared to be only partly digested berries—long before I had removed the skin. These I squeezed, quite uninten-

tionally, from the anus as I was wrestling with the problem of skinning over the tail.

The seeds were covered with a translucent pulp so viscous that it stuck first to the feathers (which I was trying hard to keep clean), then to my fingers. I had to wipe my fingers thoroughly in getting rid of the seeds and stickiness. After finishing the skin I opened the body and found many more of the slimy seeds in the large intestine. Most of the berries in the stomach proper were not slimy for their outer covering was still intact.

I have collected several Cedar Waxwings since that early year. Without exception, I believe, specimens which I have taken in the southern United States have had partly digested mistletoe berries in their alimentary tracts. In recent years, in México, I have become acquainted with other confirmed mistletoe-eaters, notably the beautiful little stub-tailed 'tanagers' known as euphonias. Along the Río Sabinas, in southern Tamaulipas, the Bonaparte's Euphonia (*Tanagra lauta*) and slightly smaller Lesson's Euphonia (*T. affinis*) are common, and both are fond of the orange-colored berries of a *Phoradendron* which grows luxuriantly in the lowlands thereabouts. Small flocks of the birds bound along from clump to clump, eating gluttonously. So exclusively do they feed on these berries that, if one wants to observe them, all one has to do is wait a short while near a clump whose berries are ripe.

While collecting specimens of these euphonias in 1938, 1939 and 1941 I noted that invariably the lower intestine contained partly digested mistletoe berries and very little else. I did not, regrettably, examine the stomachs.[1] I made a point of frightening the feeding flocks with a sudden slapping of hands, causing them to fly off. Not badly alarmed, they alighted close by for an instant of chirping and defecating. Examining the droppings which fell, I found these to contain—again invariably—partly digested mistletoe berries. The phenomenon struck me as strange. There were mistletoe berries by the thousand in the vicinity, food enough for all the euphonias and to spare. But why this incomplete digestion? Why not half as much swallowing and twice as much digesting? The more I pondered the question the busier my mental image of the birds seemed to be. Their quest for this favorite food seemed to be little short of frantic.

[1] Wetmore (1914. *Auk*, 31: 458–461), in discussing the alimentary tract of the Puerto Rican Euphonia (*Tanagra musica sclateri*), calls attention to a "degeneration of the ventriculus into a thin membranous band and a straightening of the stomach to facilitate the passage of food . . ." Wetmore believes that these euphonias subsist entirely on mistletoe berries and that they break the "outer skin with their bills and swallow the single seed surrounded by its adhesive pulp." Euphonias which I have observed in México appeared to be swallowing the berries whole. Further observations are in order. Too, the possibility that the genus *Tanagra* belongs in the Dicaeidae rather than in the Thraupidae must be carefully investigated. This would seem to be a fantastic suggestion, to be sure, but the resemblance in size and proportions between *Tanagra* and some dicaeids is certainly close.

In Hidalgo, in 1939, and in Michoacán, in 1949, I became acquainted with another euphonia, the very beautiful Blue-hooded species, *Tanagra elegantissima*, the subject of our frontispiece. I was prepared to find this bird fond of mistletoe. The first individuals I ever saw (in the mature oak woods above Jacala, Hidalgo) led me to clumps of mistletoe within a few minutes after my encountering them. When I skinned them I found highly viscous, partly digested berries ready to leave the anus.

In Michoacán, the Blue-hooded Euphonias which lived near Roger Hurd's and my camp along the old Pátzcuaro trail in the early spring of 1949 shared their mistletoe with a larger bird—the elegant Gray Silky-Flycatcher (*Ptilogonys cinereus*). I watched these delightful birds gorging on mistletoe berries and was not in the least surprised, on skinning them, to find partly digested berries in their lower intestines. In addition to the many greenish white berries in their stomachs were a few large, elongate, dark blue berries which were wholly unfamiliar to me. These, I was later to learn, on seeing them in the woods, were mistletoe berries of a wholly different sort. Whether they ever passed through in a partly digested state, I cannot say. The only berries of that sort which I found in a Silky-Flycatcher were in the stomach and were wholly undigested.

In Michoacán, in 1949, I spent much of my time painting. Working, as I did, literally for hours under mistletoe-laden trees in which both Blue-hooded Euphonias and Gray Silky-Flycatchers fed, I was much impressed with the fact that their droppings only rarely seemed to reach the ground. I might never have been conscious of this had not caterpillar droppings at times become a great nuisance. Climbing up to investigate, I found the birds' droppings, dozens of them, some on the very tops of twigs or branches, some clinging to the sides, and all stuck fast to the bark, ready—I could but guess—to become little sprigs of mistletoe once germination was brought on by rain. The birds' tendency to keep high—to rest, after feeding, in the very treetops—must, I reasoned, be aiding the mistletoe in its 'struggle to survive,' for the higher the birds perched the less likelihood there was that one of those precious droppings would reach the ground.

I am no botanist, to be sure. What I have just said probably is a slight exaggeration, too. Surely further observations are to be made. But is it not remarkable—is it not, in the best sense of the word, *wonderful*—that the process of evolution should have brought about on the one hand an edible berry, and on the other a digestive apparatus and process which eliminates that berry's skin, but allows the viscous covering of the seed to remain until, out of the bird's body at last, it serves to attach that seed to the branch on which the plant is later to grow?

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THE REFRACTORY PERIOD OF TESTIS RHYTHM IN BIRDS AND ITS POSSIBLE BEARING ON BREEDING AND MIGRATION

BY A. J. MARSHALL[1]

ACCORDING to Burger (1949: 222) the "problem of refractoriness is perhaps the greatest relatively unsolved problem in reproduction." Actually, except in ultimate detail, the problem may have been solved (Marshall, 1949a; 1950a). The "refractory period" of Bissonnette (1931; 1937) and certain other authors is here defined as that period of the avian testis cycle when the tubules are in a state of post-spermatogenetic lipoidal metamorphosis and before the newly regenerated Leydig cells of the interstitium have become sufficiently lipoidal and mature to respond to neurohormonal influences *initiated by natural factors in the environment.*

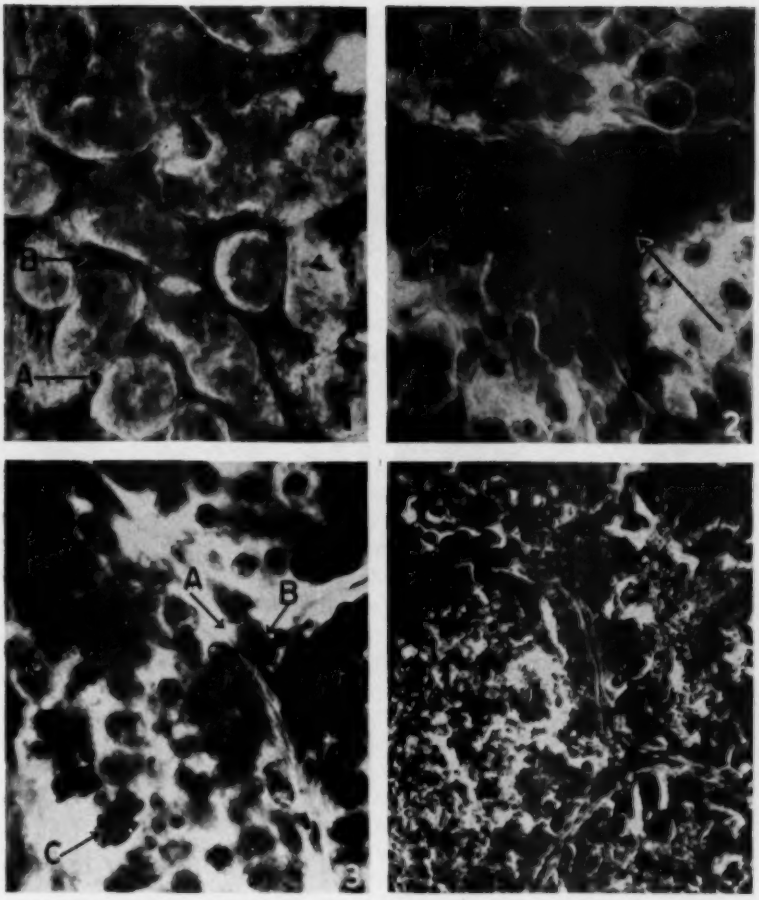
The term *neurohormonal* as used in this paper refers to the interaction of the exteroceptors, the hypothalamus, the anterior pituitary, and the gonads. The term *lipoid* has, of course, no precise chemical meaning, but used histochemically in its widest physical sense, it includes fats and all other animal substances that, in solubility, resemble fats (see Baker, 1946). It is hardly necessary to emphasize that the interstitial and tubule lipoids mentioned above have no direct connection with the gross deposits of peritoneal and subcutaneous fat that Wolfson (1942; 1945: 125) avers is a diagnostic concomitant of readiness to migrate.

The period of testis reorganization described above varies in duration from species to species. While it is in progress the post-moult summer and autumn sexual display, described for many passerines and other birds, occurs.

Internal Rhythm of the Testis

Before discussing in detail the refractory phase of the testis in relation to the breeding cycle and to light-experimentation which has been carried on since Rowan's (1925) remarkable pioneer discovery, it is best to see the phenomenon in its true perspective within the gonad cycle. In the young bird the inactive tubule contents are free of lipoids (Fig. 1). The interstitium contains juvenile Leydig cells that exhibit cholesterol-positive lipoid droplets which increase in quantity until many of the cells reach an almost maximum size at a time when the contents of the adjacent spermatogenetic tubules (and the bird's plumage in some species) also indicate approaching sexual maturity.

[1] Grateful acknowledgment is made to Dr. C. J. F. Coombs of Cornwall, and to Angus Robinson, Esq., of Coolup, Western Australia, for permission to use specimens collected for other purposes by them.



Photomicrographs of avian testis sections. (Formal-calcium fixation and Scharlach R. colouring with Ehrlich's haematoxylin counter-staining; 15μ.)

FIG. 1. Rook, aged 11 months. × 300. A. Inactive spermatogenetic tubule. B. Tract of Leydig interstitial cells gaining in lipoid content.

FIG. 2. Adult Rook taken at about the same season as Fig. 1. × 650. Arrow indicates typical wedge of heavily lipoidal Leydig cells at a time when the first mature spermatozoa appeared in adjacent tubules.

FIG. 3. Adult Rook approaching height of spermatogenesis. × 600. The great expansion of the seminiferous tubules has dispersed the Leydig cells, which are losing their lipoids and cholesterol. A. Leydig cell devoid of lipoids. B. Leydig cell still heavily sudanophil. C. Bunched spermatozoa.

FIG. 4. Adult Australian "Magpie" (*Gymnorhina dorsalis*) that has undergone interstitial exhaustion, shed spermatozoa, and entered the refractory phase. × 320. The small black spots within the tubules are the first evidence of tubule steatogenesis. Postnuptial tubule breakdown has begun.

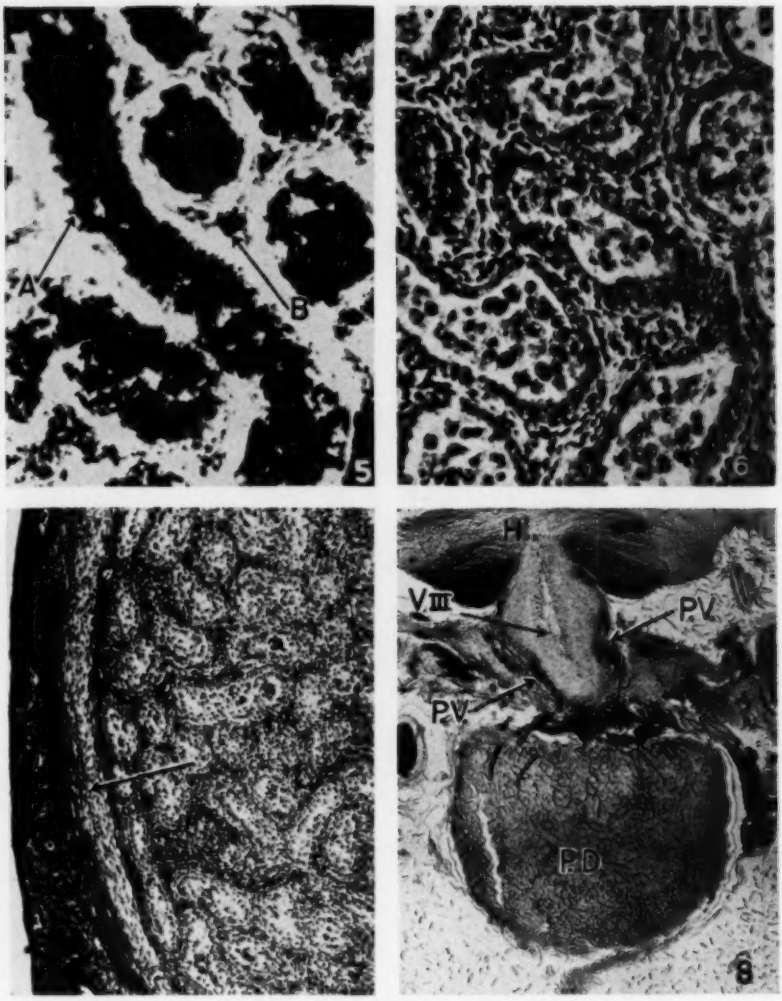


FIG. 5. Adult Rook testis in postnuptial phase of tubule metamorphosis and interstitial regeneration. × 350. A. Collapsed tubule full of cholesterol-positive lipoids. B. Group of juvenile, lipoidal, cholesterol-positive Leydig cells. (Technique as in Figs. 1–4.)

FIG. 6. Adult Rook testis as collapsed during refractory period. × 400. Note necrotic sperm debris within tubules. (Bouin fixation, iron haematoxylin, at 7μ.)

FIG. 7. Adult *Gymnorhina dorsalis* testis at stage comparable to that of Figs. 5 and 6. × 110. Arrow points to new testis wall inside old one. Testis regeneration is well under way and the refractory period is almost at an end. (Technique as in Fig. 6.)

FIG. 8. Hypophyseal portal system of adult Rook. × 25. H. Hypothalamus. V. III. Third ventricle. P. V. Portal vessels. P. D. Pars distalis of anterior pituitary. (Formal-calcium and Lepehne-Picworth method at 40μ.)

In the sexually quiescent adult the interstitium generally consists for the most part of comparatively small lipoid Leydig cells. These contain fuchsinophil elements which are readily seen after the soluble lipoids are removed by embedding in wax. As the sexual season heightens, the Leydig cells increase in size and lipoid content. Varying in quantity and arrangement from species to species, considerable aggregations of heavily lipoidal Leydig cells can now be seen (Fig. 2). The ripening spermatogenetic products expand the seminiferous tubules and this causes a wide dispersion of the clustered Leydig cells so that few are found in any given microscopic section. At the height of spermatogenesis, and at the beginning of lipoidal metamorphosis of the germinal epithelium, the Leydig cells become almost exhausted of their lipoid content (Fig. 3). An increase in the number of mitochondria may be seen in their cytoplasm (Benoit, 1927; 1929). Soon a fuchsinophil cell appears in which it is not possible to demonstrate the presence of cholesterol. There is a difference of opinion concerning the relative function of the lipoid and the fuchsinophil cell. Sluiter and van Oordt (1947; 1949) call the latter (which has also a vacuolated form) the "secretory cell" and declare that it manufactures the sex hormone. Marshall (1949a) on the other hand, considers the lipoid cell the site of hormone production and believes that the fuchsinophil cell is essentially a lipoid cell that has run its cycle and is about to disintegrate or to give rise to another generation of juvenile Leydig cells.

Concurrently, when the tubules have reached their maximum size and after spermatozoa are shed, some tubules undergo a lipoidal metamorphosis (Fig. 4). (This is quite distinct from the lipophanerosis observed during vertebrate spermatogenesis and described in all histology textbooks.) Soon the contents of all tubules become almost wholly lipoidal (Figs. 5 and 6). The tubules rapidly collapse as the necrotic spermatozoa and other debris clear away. Meanwhile, a new generation of small juvenile Leydig cells arises in the spaces between the shrunken tubules (Fig. 5) and the interstitium is invaded by new blood vessels. There now arises a prolific growth of fibroblasts which build up a new *tunica albuginea* (Fig. 7) inside the distorted and fragile old wall; the new Leydig cells become meagerly lipoidal and fuchsinophil; and eventually these become sufficiently mature to respond to external stimuli via the pituitary gland: the refractory period is ended.

The reorganization referred to above is often associated with the postnuptial moult and is probably responsible for the brief period of sexual quiescence that now ensues. Further, experimental birds cannot now be forced into spermatogenesis by increased illumination. It is not yet known to what extent testis rehabilitation is influenced by the secretion of pituitary gonadotrophins in free-living birds. Miller (1949), for example, has shown that in late October (long after the initial stages of rehabilitation) large daily injections (1 cc. = 50 international units) of pregnant mare serum quickly caused testis enlargement in wintering Golden-crowned Sparrows (*Zonotrichia coronata*) that were prob-

ably still refractory to photostimulation. Among free-living birds the tubule-lipoids disappear and the new interstitium matures at different rates from species to species. Although this writer believes that the gonad is the primary organ of periodicity, the anterior pituitary too may have a refractory phase. However, no anatomical evidence that such is the case has yet been adduced.

The postnuptial tubule lipoids are cholesterol-positive. In many bird species a sustained period of autumnal display, song, and territorial behavior begins as the postnuptial tubule lipoids disintegrate and the new interstitium develops. The tubule lipoids may, during their postnuptial existence, have an endocrine function, but this has not yet been proven.

The above metamorphosis, even though it involves testis collapse, cannot be termed simply a "regression" since it involves the rehabilitation of the interstitium, the tubules and the testis tunic. Until the tunic has been rebuilt and the Leydig cells renewed, the next spermatogenesis cannot, of course, occur. The metamorphosis, in addition to the subsequent "spring" development of interstitium and seminiferous tubules, constitutes the physical basis of the internal rhythm postulated by F. H. A. Marshall (1936) and Baker (1938a) in their classical reviews on sexual periodicity and the evolution of breeding seasons.

It should be mentioned that interstitial Leydig cells appear to be present throughout the life of the bird. Authors have sometimes considered these cells absent because inappropriate techniques have removed the cytoplasmic lipoids and thus rendered the cells unidentifiable.

Experimental Photostimulation and the Refractory Period

Since Rowan's epochal discovery that photostimulation led to testis-response in the Junco (*Junco hyemalis*), many other birds have been found to respond in the same way. It is unnecessary here to refer specifically to the several excellent reviews of the work on the effects of light duration, light intensity, and the components of light on captive birds, or to the various ingenious experiments of Benoit in trying to determine the neural pathway by which light from the environment finally leads to the activation of the hypophysis. There seems no reason to believe that sunlight and other external stimuli conducive to breeding do not achieve a nervous threshold which leads to the stimulation of the anterior pituitary via the hypophyseal portal system that is present in birds (Fig. 8) as well as in various other animals (Popa and Fielding, 1930; Houssay, *et al.*, 1935; Wislocki and King, 1936; Green and Harris, 1947; Harris, 1948). Avoiding the "light versus metabolic activity" controversy, we can say, in general, that if seasonal birds are subjected to additional rations of artificial light outside the refractory period their testes will enlarge.

In the light of the above demonstration of the anatomical basis of the refractory period, several previously puzzling aspects of photostimulation can be readily understood. Bissonnette and Wadlund (1932: 345), commenting on

the "failure of the sex mechanism to maintain a high rate of germ-cell multiplication and maturation beyond a definite period," state that "the more stimulating the effect of the illumination, the more quickly is the mechanism thrown out of gear." There seems little doubt that the above workers, and many others, experimentally drove the birds through their spermatogenetic and interstitial cycles to sexual exhaustion and, not understanding the mechanism involved, called the subsequent period of reorganization (when the testis was temporarily unresponsive to further stimuli) the refractory period. It is interesting that both Rowan (1929) and Bissonnette (1930), who worked with traditional wax-section techniques, remarked on the presence of tubule vacuoles at the post-spermatogenetic stage. Rowan in particular mentioned that these "vacuities" appeared as though artificially produced; but he emphasized that they were not artifacts. He was, of course, correct: they are the empty spaces left where the metamorphosed fats have been dissolved out of the sections after wax embedding.

It will be recalled that Riley (1936; 1937) found that the testes of adult House Sparrows (*Passer domesticus*), though unresponsive to photostimulation in September were responsive in November. By November (in the Northern Hemisphere) postnuptial reorganization has proceeded sufficiently to allow the testis to respond. Likewise, Riley's success in stimulating juvenile birds in September is understandable when we realize that their tubules, never having produced spermatozoa, have not metamorphosed, and their lipoid Leydig cells are still developing and are therefore receptive to the stimuli of additional lighting. It becomes clear, too, that there is nothing remarkable in the experimental production of more than one spermatogenesis in a year; and the histophysiology of the ancient practices of *yogai* (Miyazaki, 1934) and *mewing* (Damsté, 1947) can be readily understood.

Seasonal Stimuli after the Refractory Period

We can now consider birds as free-living animals in touch with all of the varied stimuli that keep their breeding cycles in step with the seasons and ensure for their young an arrival time suitable for survival.

After the breeding season there is among some British birds an almost general recrudescence of singing, courtship display, and other forms of sexual behaviour which may continue into autumn and winter (Morley, 1943). Again, in North America, the Mockingbird, *Mimus polyglottos* (Michener and Michener, 1935), Song Sparrow, *Melospiza melodia* (Nice, 1937), White-crowned Sparrow, *Zonotrichia leucophrys* (Blanchard, 1936), Wren-tit, *Chamaea fasciata* (Erickson, 1938), Ring-necked Pheasant, *Phasianus colchicus* (Hiatt and Fisher, 1947), and other species have been reported to exhibit varying degrees of sexual activity in the autumn. In some British species, notably the House Sparrow, Starling (*Sturnus vulgaris*), Wood Pigeon (*Columba palumbus*), Stock Dove (*C. oenas*), Robin (*Erithacus rubecula*), and Blackbird (*Turdus merula*), this

characteristic post-moult activity may occasionally lead to autumn reproduction (Witherby, *et al.*, 1948) if weather and food conditions remain propitious. It is noteworthy that some of these occasional autumn breeders exhibit pronounced autumnal sexual activities in North America (Witschi, 1935; Allard, 1940).

Bullough (1942) has shown that in England testis-size in the Starling begins to increase in September. This is accompanied by autumnal sexual activity. Höhn (1947) has histological evidence that autumnal interstitial development in the Mallard (*Anas platyrhynchos*) is followed by mating behaviour.

In three British species—the Rook (*Corvus frugilegus*), Robin, and House Sparrow—the relation of autumnal sexual activity to internal testis rhythm has been studied. The Rook (Marshall and Coombs, unpublished) ovulates in March in Cornwall; the testis tubules rapidly metamorphose and the interstitium begins to regenerate while incubation is still proceeding. Males shot whilst carrying food to the young in the nests possessed collapsed tubules heavy with lipoids and an interstitium already regenerated with Leydig cells meagerly lipoidal and correspondingly responsive to the Schultz test for cholesterol. After this rapid testis reorganization there appears to be a comparative lull in development. The tubules lose their lipoids very slowly and the Leydig cells appear not to develop further. Meanwhile moult has begun. By the end of June the young birds flock separately and require no further attention from the parents. With the testis tubules still lipoidal and with moult proceeding, a new *tunica albuginea* is being laid down in readiness for the next enormous expansion of the organ. By the end of August wing and tail feathers have been replaced and the new testis wall is complete. There are still plenty of metamorphosed lipoids in the tubules but a new growth of spermatogonia is present beneath them and almost all of the necrotic sperm debris has been eliminated. Also, there is a slight increase in the size and lipoid content of the Leydig cells.

It is now that the Rooks renew their "mating flight" and many start carrying sticks to their old nests. Most, if not all of the characteristic spring courtship behaviour occurs, including, occasionally, copulation (Morley, 1943). In a small number of males, testis development begins in September and culminates in complete spermatogenesis in October. It is remarkable that in the great bulk of a given rookery there is no considerable change in the testes. Despite the extraordinary—and regular—sexual resurgence described above, Rooks almost never actually reproduce in the autumn. During a normal winter the testes that do develop begin to metamorphose when sexual activity dies down in November. "Spring" gonad development begins in December at about the winter solstice or a little later. The time of onset varies among individuals and also from year to year according to the weather. Study of the female sexual cycle is still in progress.

The above detailed data about a single species are given here because they have an important bearing on the question of the validity of photoperiodic

stimulation of birds in nature. Among many species sexual behaviour occurs after the regeneration and partial development of the interstitium, whether the days are lengthening or shortening. When the moult is concluding and the young are able to care for themselves (or even before), postnuptial sexual behaviour may become very pronounced depending upon the weather and the traditional habit of the species. This appears to be essentially controlled by the internal rhythm of the gonad. In southwest Britain both the Robin and the Rook breed earlier than in the north, the former also beginning its autumnal song and territorial aggression (Lack, 1939), the latter also its autumnal sexual display, earlier. If autumn weather conditions (especially sunshine) and food supply are good, autumnal sexual behaviour is extremely pronounced. In the Robin it may lead to reproduction in a few individuals (Lack, 1946). The chief point to be emphasized is that though light is decreasing sexual activity is increasing. It is not until November, when the sun is rarely seen, when weather conditions are worsening considerably and food is becoming scarce, that sexual activities are inhibited. It has been suggested that autumnal sexual activities are depressed when day-length falls below a certain number of hours, but there appears to be no good evidence that mere shortness of day is responsible. Other environmental factors seem to be far more important.

Again there seems to be no sound evidence, apart from that obtained through photostimulation experiments in cages, that the onset of "spring" sexual activity is correlated directly with any precise day length. There has been no widespread histophysiological investigation of the gonads in the winter period when many spring-breeding species begin their seasonal spermatogenesis. Data about to be published reveal that at Oxford, England, the Robin, a spring-nesting bird, exhibits an interstitial rearrangement and a sudden growth of Leydig cells in the first week of January. There is at the same time a marked revival of song. Pairing takes place. This occurs after a light-increase of approximately 12 minutes from the winter solstice, when day-length is increasing at the rate of about one minute per day. Before it can be unquestionably accepted that light fluctuation causes the above prenuptial sexual recrudescence, far more elegant experimental techniques than those used in the past will have to be devised.

The Starling, on which much photostimulation work has been done, is of great interest here because of the detailed histological study by Bullough (1942). Burger (1949) reports that the minimum day-length required by this species for the rapid production of spermatozoa is about 12.5 hours, and that days 10.5 hours long produce only the multiplication of spermatogonia. But under unusually mild winter conditions in Britain, Starlings will not only produce spermatozoa but will nest, ovulate and bring out viable young when the days are little more than nine hours long. Further, an analysis of Bullough's data shows that under natural conditions a "great burst" of testicular growth occurs at the beginning of February when the days are only about 9.3 hours

long, and that by the end of the month the first sperms have appeared when the days are about 10.6 hours long. Spermatogenesis is reported to have continued rapidly although day-length was still little more than that which Burger was later to claim could produce only the multiplication of spermatogonia. These facts are brought forward to show how far from reality can be the most carefully planned and regulated photoperiodicity experiments.

So much for light and the *initiation* of the prenuptial part of the breeding cycle. What, now, of ovulation? Summarizing an important survey (which of necessity dealt with selected species having wide geographical ranges) Baker (1938b: 578) stated: "6. Much egg-laying occurs when days are getting shorter, and indeed it often proceeds rapidly while they are decreasing in length and only between 11 and 12 hours long.

"7. There is, however, little egg-laying when the day is shorter than 11 hours, and almost none when it is less than 10.

"8. Under natural conditions birds exhibit no tendency to start breeding everywhere when the days reach a certain length nor when they are becoming longer particularly quickly."

There is ample evidence that the timing of ovulation in a given species, even in the same locality, has no direct relationship with day-length. Records kept by the Marsham family in Norfolk, England, for the past two centuries reveal that the first appearance of young Rooks varies from 23 March to 2 May (Williams, 1949). There are numerous published data (*cf.* Marshall, 1949b) indicating that the breeding season fluctuates according to the mildness or severity of the weeks preceding nesting. When it became known that the British winter of 1946–47 was one of the coldest on record it was thought worthwhile to collect the gonads and stomach contents of a small series of four common Oxford passerines—the Robin, Chaffinch (*Fringilla coelebs*), Great Tit (*Parus major*), and Blue Tit (*P. caeruleus*)—in mid-March in the hope that the following winter would be normal and the same species might be obtained in precisely the same wood exactly one year later. The winter of 1947–48 was unusually mild; the proposed second collection was made. The experiment was designed to rule out day-length as a factor and to test the effects of possible weather fluctuation.

There proved to be a great disparity between the gonads taken after the "hard" winter and those collected after the mild one. From March 13 to 15, 1947, none of the four species showed a greater development than primary spermatocytes in synizesis, whereas those collected exactly one year later had all reached secondary spermatocyte stage, and three of the four species had developed spermatids or spermatozoa. Analysis of weather and breeding records showed that the hard winter was followed by an abnormally bright spell (after the collection date) and that the surviving birds of at least three species bred at about the normal time! It is, of course, extremely difficult to evaluate such factors as sunshine, temperature and food abundance. Great care was

taken to provide an adequate food supply for all birds collected in both winters. So, unless some special food component was operative, it seems that sunshine and temperature must have been particularly influential in the timing of the cycle.

Evolution and Timing of the Breeding Cycle

The ultimate factor (Baker, 1938a; 1947) in the evolution and timing of the breeding season is reproduction at a time of year propitious for the rearing of the young and thus also for the survival of the species. Secondly, there are *proximate* or immediate factors in the animal's environment acting as regulators and operating through the exteroceptors, thus keeping the breeding rhythm anchored to the seasons. Animals that do not respond to the appropriate stimuli may continue to lose their offspring and thus pay the death penalty as species.

The above regulation may be achieved in either of two ways or through a combination of the two ways:

1. The sexual cycle, once the period of postnuptial reorganization (or "refractoriness") is over, is under the control of a complex of regulating factors that occur at approximately the same times every year and so, ultimately, the young are launched at about the same beneficial period each year.

2. There is a possibility that in many species (particularly migratory ones) the male cycle is timed principally by a fixed rate of gonad reorganization, i.e., the clearance of last season's metamorphosed lipoids from the spermatogenetic tubules and the building up of the secretory component of the interstitium. If this be so, migration and breeding activity could begin, irrespective of light duration, weather, or geography (e.g., among birds on the equator), after the Leydig cells had reached a certain threshold of hormone production. The sexual cycle, then, must be finally timed by the external immediate factors (presence of appropriate nesting sites, food, etc.) that permit successful reproduction when migrants or dispersive species reach their breeding grounds. The breeding cycle is still under the more or less rigid control of the environment and thus keeps step with the sun.

This second matter can be dealt with first. Bissonnette (1937: 257) has suggested that the breeding cycle and migration in some species might be governed by "inherent rhythms of the anterior pituitary more or less fixed in the absence of, or without responsiveness to, external, usually stimulating, factors like light cycles." Previously, however, Baker and Baker (1936: 517) had expressed their belief that "if in any plant or animal there were an internal rhythm controlling an annual cycle, and if this rhythm were incorrect even to the minute extent of six minutes in the year, then if it were breeding in the spring at the end of the last glacial epoch in the northern hemisphere it would be breeding at precisely the wrong season of the year (autumn) now!" From what is known of the time factor in biological reactions any such exactitude is inconceivable; furthermore, there is as yet no evidence that the anterior pituitary is auton-

omous in its activity. F. H. A. Marshall (1936; 1942) and Baker and Ransom (1938: 103–105) have, however, pointed out that certain Southern Hemisphere birds appear to adhere to their southern breeding times after transportation across the equator even though the majority soon adjust to the new environment. Thus, it would seem clear that some birds possess an internal rhythm of reproduction. Baker (1938a) has suggested briefly that some such rhythm may prevent migratory European Swallows (*Hirundo rustica*) from nesting in the South African summer and that it may be influential in timing the return of migrants to their breeding grounds. The present writer, in view of material presented in this paper, suggests that a fixed rate and period of gonad reorganization may be influential in timing the departure of spring migrants. The testis tubules of certain waders in northern Africa are clear of lipoids and their Leydig cells are fairly constant in lipoid content at the time of their departure northward (Marshall, 1950b). The same is true of the Hooded Crow (*Corvus cornix*) before it leaves eastern England for its Scandinavian breeding grounds (Marshall and Coombs, unpublished). Passerine birds of eight species[2] so far investigated contain spermatozoa when they kill themselves against St. Catherine's Lighthouse, Isle of Wight, on their spring migration from Africa and southern Europe. This evidence reinforces Rowan's contention (see also Rowan and Batrawi, 1939) that the northern migratory journey is essentially sexual in motivation. It is difficult to see how the day-length hypothesis can explain the northern movement of birds that "winter" near the equator. Thus, of two individual Golden Plovers (*Pluvialis apricaria*) of the same subspecies, one may winter a little to the north, the other a little to the south, of the equator: the former exists under an increase of light, the latter under a decrease, yet both apparently arrive at their northern breeding grounds at approximately the same time. And if light is not influential, what other environmental factors are sufficiently constant over a wide area to be considered at all?

It seems certain that the urge to move towards the traditional breeding ground is inherent within each species, even as is the appreciation of the environmental pattern that allows for mating, ovulation and nidification when the birds get there. Even if migratory birds "winter" with potential mates in an area of abundant food, sunshine and prolonged day-length, other environmental factors essential for reproduction (e.g., traditional nest sites) are not present and therefore the cycle cannot be stimulated vigorously enough to bring about an unseasonal "autumnal" or postnuptial breeding condition. It seems possible, then, that in many migratory species there is a genetically fixed rate of testis recovery, and that when the rhythm has proceeded to a certain threshold any environmental stimuli (including behavioural interactions between the sexes) that influence the anterior pituitary can then be

[2] Whitethroat (*Sylvia communis*), Blackcap (*S. atricapilla*), Willow Warbler (*Phylloscopus trochilus*), Pied Flycatcher (*Muscicapa hypoleuca*), Spotted Flycatcher (*M. striata*), Wheatear (*O. œnanthe*), Redstart (*P. phœnicurus*), and Sedge Warbler (*Acrocephalus schœnobaenus*).

operative on the now once more responsive gonads. Storr (1951) has recently described display in flocking Sharp-tailed Sandpipers (*Erolia acuminata*) in tropical Queensland (at Lat. 15° 22′ S.) in March and early April shortly before their departure for their arctic breeding ground. In the case of young birds, a fixed maturation rate may be the essential timing factor: once a certain sexual maturity is reached, environmental factors may be able to operate and to achieve a neurohormonal threshold sufficient to cause departure for the breeding ground. It will be recalled that when Emlen and Lorenz (1942) implanted sex-hormone pellets in free-living, sexually inactive California Valley Quail (*Lophortyx californica*), neighbouring, untreated birds also showed accelerated mating behaviour. In regard to this kind of sexual and social stimulation, F. Fraser Darling's "Bird Flocks and the Breeding Cycle" (1938) should be consulted.

The breeding rhythm of stationary Sooty Terns (*Sterna fuscata*) which are reported to breed about four times every three years on tropical Ascension Island (Murphy, 1936) is of outstanding interest. Here, apparently, the ocean environment contains sufficient quantities of food to allow more frequent successful reproduction than is usual in seasonal birds. Were this species an arctic migrant, such a rhythm would carry it north into an unpropitious climate and natural selection would operate swiftly and disastrously.

When migrants arrive at their traditional breeding grounds, the presence of an appropriate pattern of environmental stimuli allows them to breed and their reproductive cycle thus keeps step with the sun. In this respect the Great Skua (*Catharacta skua*) is noteworthy. It breeds widely throughout antarctic and sub-antarctic seas but a separate northern subspecies nests in Iceland (Huxley, 1950. *Discovery*, 11: 73–78). Although probably non-migratory, the Great Skua wanders north and south from its sub-polar breeding stations (James Fisher, personal communication). Both Huxley and Fisher have suggested that the northern population was established by nomads from the south. Thus we can visualize trans-equatorial wanderers covering thousands of miles of ocean and islands before finding northern quarters with an environment sufficiently like that at home to enable them successfully to breed and to found an arctic race.

A fixed rate of gonad recrudescence may explain some of the cases where, in certain restricted localities, two populations of the same species (sometimes, apparently, the same subspecies) co-exist and yet retain different breeding rhythms. Serventy and Whittell (1948) have reported separate winter and spring breeding populations of several species of sea-birds on islands off the west coast of Australia. In the case of the Silver Gull (*Larus novae-hollandiae*), two groups breed at different times on one small island. All colonies of Pied Cormorants (*Phalacrocorax varius*) but one breed in autumn and winter; the exceptional colony, on the Abrolhos Islands, breeds in the spring. On the other side of the continent, Barrett (1910) long ago noted that large numbers of

White-capped Noddies (*Anoüs stolidus*) on one Great Barrier Reef atoll had eggs on a certain date, while a second population, on a very similar island only 15 miles away, had not begun to lay.

In North America Blanchard (1941) and Blanchard and Erickson (1949) have shown that the gonads of two subspecies of *Zonotrichia leucophrys* living part of the year in the same area and exposed to the same day-lengths begin to enlarge at different times. Wolfson (1942) has interesting data of the same sort concerning races of *Junco oreganus;* and Bullough (1942) has shown that in Britain migratory populations of Starlings have different breeding cycles from those of non-migratory populations.

It seems probable that in temperate zone species such as the above there are environmental factors operating near the ovulation date and allowing of a successful mating when the habitat becomes seasonally appropriate for reproduction. Thus, too, it may be found that the external stimuli governing nidification and ovulation are the really important factors that keep the individual sexual cycles in step with the seasons rather than a long-range factor, such as day-length which is generally held to be the chief factor that anchors the sexual cycle in time.

Among certain birds inhabiting countries where the winter sky is usually overcast it seems that a principal long-range environmental influence is sunshine rather than mere length of day. An unseasonable burst of sunshine in winter will stimulate birds to sing; a spell of dull cold weather in spring will depress song and sexual activity. Inhibitory influences which prevent animals from wasteful unseasonal matings are sometimes as valuable biologically as stimulatory ones. A long succession of days suitable to reproductive development will heighten sexuality irrespective of day-length; and a period of adverse weather, even when days are lengthening, will depress it, thus delaying the sexual season. Sunshine may not play a great part in the timing mechanism of birds inhabiting countries whose winters are sunny; but the Oxford open-air experiment described above should make it clear that in dull-winter areas sunshine is important and that, furthermore, sunshine and day-length are not precisely the same thing. Much as an anthropomorphic parallel may be deplored, it is natural to cite *Homo's* feeling of exhilaration and general well-being in a mountainous or arctic region—even in subzero temperature—when the sun shines. The results of much of the photostimulation work can be explained in this way. If birds that have evolved a neurohormonal response to sunshine are subjected to electric or candle light (*muit, yogai*) it is understandable that the mechanism will be set in operation and that hypophyseal hormones will eventually reach and activate the gonads. In this context it can be recalled that the introduction of all sorts of alien substances into various parts of an animal will stimulate reproductive activity (F. H. A. Marshall, 1936). In the course of an investigation of a chicken disease, Asplin and Boyland (1947) observed that sulphonomide administration was followed by spermatogenetic

activity and precocious sexual development (e.g., comb-growth) and sexual behaviour in week-old chicks.

Neither sunshine nor light-increase can be said to possess a stimulatory effect in the cycle of the Emperor Penguin (*Aptenodytes forsteri*), which brings out its young during the darkest, coldest, most tempestuous period of the year. On the other hand, the Adélie Penguin (*Pygoscelis adeliae*) of the same latitude hatches its egg during the lightest and warmest month, December. Levick (1914) has described the astonishing differential growth-rate of the two species—the "mushroom-like" development of the Adélie, which enables it to mature sufficiently to survive the following winter, and the slow growth of the Emperor chicks, which are carried about and warmed by their parents until the approach of better weather. We can only assume that *if* day-length has any influence on the rhythm of the Emperor Penguin, *decrease* in day-length is what stimulates its development. In this respect the carefully controlled investigation of Yeates (1949) demands consideration for it appears to prove (under very "natural" experimental conditions) that the autumnal reduction in daylight over a long (13–16 weeks) period somehow stimulates the oestrus cycle of Suffolk ewes to activity and to actual reproduction. Autumnal mating in sheep and in certain other mammals leads to a beneficial spring parturition.

Most birds hatch their young at a period when the days are long enough for obtaining the stupendous amount of food needed by the developing young. Also, when days are long the weather is so mild that the comparatively naked young are not frozen to death. Further, during the season of long mild days the food necessary for the young is at its maximum (Marshall, 1951: 270). But most of the evidence is against the probability that each species has evolved an exact relationship with its environment whereby, when the day reaches a certain length or when the sun arises at a certain time, its breeding cycle "ticks over" to launch the young at a specific time of the year. That daylight increment, allied with other factors, may be partly influential in timing the breeding cycle of some species cannot be denied; but the influence of this daylight increment has been grossly over-emphasized, and many of the photoperiodic manipulations designed to test its importance have been made under conditions having little correspondence with normal events in the lives of the birds involved.

We now know that most of the old travellers' tales of equatorial animals "breeding all the year round" are untrue. Individual tropical birds seem to have breeding seasons as sharp as those of the same families living in Tasmania, Sussex or Vermont. The Oxford University Expedition that established a laboratory for one year in the remarkably unvarying climate of the New Hebrides proved conclusively that the endemic race of the Golden Whistler (*Pachycephala pectoralis*) has as sharp a breeding season as that of another race in southern Australia (Baker, Marshall and Harrisson, 1940). In the New Hebrides (below the equator) the species ovulates when the days are growing

shorter. In southern Australia (below the equator) it ovulates when days are growing *longer*. The same applies to other Australian birds living in approximately the same latitude as the New Hebrides. There is much other, though histologically less conclusive, evidence that birds living almost precisely astride the equator have sharp breeding seasons (Moreau, Wilk, and Rowan, 1947). Notable, too, is the fact that individuals of species which inhabit both sides of the island of Ceylon breed at different times of the year. The monsoon that brings rain to the southwestern side of the island comes at a different time from that bringing rain to the opposite side (Wait, 1931). The wide variation in breeding periods may be correlated with the monsoons.

A further argument against light in any form as an overall regulator is provided by the irregular cycles of many species of birds in countries where rainfall is scanty or spasmodic. Here, quite often, breeding dates are indubitably geared to rainfall or its immediate effects.[3] Carnaby (1946) states that northwestern Australian birds can be divided into several groups. Some (certain pigeons and quail and many passerines) breed at any time of the year following heavy rain. The seed-eating Budgerigar (*Melopsittacus undulatus*) and Zebra Finch (*Taeniopygia castanotis*) breed after the growing of grass following such rain. Certain species ovulate in a particular calendar month, but only if conditions are normal for the period. Finally, a few large birds of prey have a regular breeding time irrespective of environmental fluctuation. Serventy (1946) has an important account of spring-nesting Western Australian species breeding in autumn after heavy unseasonable rainfall. A little farther south, beyond the area of rainfall, there was no indication of unusual breeding. Robinson (1933) reports that the Dusky Wood-Swallow (*Artamus cyanopterus*) nests in the Western Australian autumn (when light is decreasing) if rain falls, and nests again in mid-winter if it rains again. Roberts (1937: 51) has collected evidence that in central Queensland Plum-headed Finches (*Aidemosyne modesta*) lay only when heavy rain brings on a good crop of grass with seeds; the finches begin building immediately the grass becomes long. Scrub-turkeys (*Alectura lathami*) in the same area begin raking rubbish onto their old incubators only after the first rains of the season. If the "wet" continues they will lay. In one season of abnormal rainfall these megapodes laid in wintertime. They rely, of course, on heat generated by the damp, decaying vegetation of their incubators to hatch the eggs. Makin informs the writer that in southwestern Queensland, where wet winters are exceptional, she observed several kinds of spring-breeding birds nesting before the winter solstice after unseasonable rain. In this respect, Orr's (1945) evidence concerning Galápagos finches (*Geospiza*) is of importance. Members of this genus apparently breed from mid-December to April during the wet season when in a wild state near the equator. In captivity in California, however, they generally nested from March

[3] A. R. Phillips has reported that the Rufous-winged Sparrow (*Aimophila carpalis*) does not breed in Arizona in spring, but delays "until the summer rains" (see page 323 of this issue).

to November, the breeding period of most North American birds. If the captive equatorial finches had been, in fact, native species their breeding during March–July would no doubt be ascribed to day-length. It would seem that some xerophilous or other species, which have of necessity evolved a neuro-endocrinal cycle to respond to rain or its effects will breed at any time of year after a short postnuptial period of testis reorganization. A long, fixed period of reorganization would be fatal—the species would, perhaps, be refractory to external stimuli until long after the next rainfall and the passing of its beneficial effects. The above Australian references are mentioned because they are unfamiliar to most people; comparable data are available from other continents. Baker (1938a) in particular has gathered observations suggesting that the timing of breeding seasons is dependent on a wide variety of factors. There seems little reason to doubt that various species (or different populations of one species) have evolved a breeding reaction to entirely dissimilar environmental complexes and so enabled themselves to breed in all manner of habitats quite independently of the movements of the sun *per se*.

An invaluable method of inquiry into the causes of breeding season—and one that has not been seriously exploited—is the examination of environmental factors, or lack of factors, that inhibit breeding. Spasmodic non-breeding in birds and other animals is extremely common in all habitats subject to violent environmental fluctuations. Berney (1927) reported the complete inhibition of breeding of most species for 16 months in central-west Queensland. Manniche (1910) noticed that during one period many North Greenland birds failed to reproduce. He correlated the non-breeding of the Long-tailed Skua (*Stercorarius longicaudus*) with the absence of its normal food, the lemming. The observations of Schaanning (1916) in Novaya Zemlya, and of Pedersen (1930) and Løppenthin (1932) in East Greenland indicate that inhibition of breeding in the Long-tailed Skua, Pomatorhine Skua (*S. pomarinus*), and Snowy Owl (*Nyctea scandiaca*) is closely related to the lemming cycle which, as Elton (1924; 1942) has shown, occurs in a regular 3–4 year rhythm. When lemmings fail there is a widespread non-breeding among lemming-feeders. Marshall (unpublished) found that on the bleak, foggy island of Jan Mayen (east of Greenland) non-breeding in some species appeared to be caused by the lack of nesting sites safe from fox-persecution. Certain species that show no great conservatism in site-selection elsewhere nested almost entirely on lofty cliffs and pinnacles on this fox-infested island. Passage waders touched down in thousands but only a few remained through the summer and these did not breed. No wader has ever been recorded breeding on this island. Stomachs of the many waders shot by us contained only vegetable matter. The testes of summer males collected contained spermatozoa, so failure to breed may well have resulted from inability of the females to find the sort of food characteristic of the traditional nuptial area. Land and lake birds of many species have been reported from Jan Mayen by various expeditions, but only a very few breed

there even though every day at the summer's peak provides 24 hours of light. The sun, however, rarely penetrates the heavy blanket of fog surrounding the island and most migratory and dispersive species do not find there an environmental pattern appropriate to their traditional reproductive needs. The only birds that breed freely are the cliff-nesting seafowl that can escape the fox population (which is confined to the island except during winters when the pack-ice allows egress across the sea to the Greenland coast) and that can find unlimited food in the surrounding sea. The testes of non-breeding species underwent the same spermatogenetic cycle as those of the breeding species, but in development lagged behind those of paired breeding birds. It seemed that both sexes of birds in a flock became potentially capable of reproduction but that lack of suitable external stimuli (e.g., those provided by a satisfactory breeding site and/or appropriate food) inhibited the final stages leading to fulfillment.

There is now abundant evidence that once the gametogenetic cycle of many birds is started off it is "kept on the rails" by a variety and a succession of immediate factors such as weather, display, food supply, nest-site availability, and so on. For example, the Australian Satin Bowerbird (*Ptilonorhynchus violaceus*) takes up territory and builds a bower and a display ground on which it places numerous decorative objects at about mid-winter (June) when light is decreasing or increasing at the rate of a few seconds per day (Marshall, 1950c). Within a month the male gonad has increased in size a hundredfold and bunches of spermatozoa have appeared. But the male continues to display to the female at the bower until late in September or early in October when the female goes off to build her nest. Nidification thus takes place when the forest becomes full of flying insects. It has been shown experimentally that bowerbirds are unable to seek out small insects that they do not see moving and that the fruit diet on which the adults largely subsist is inadequate to bring nestlings to maturity. Here, then, we have a complex mechanism involving an early taking up of territory but an actual nidification at a time suitable for survival of the young.

Another bird whose breeding cycle seems to be timed to culminate with the appearance of specialized food is the British Robin. As mentioned previously, this species pairs and its gonads begin their "spring" development in January. Spermatozoa appear within a month provided the winter is not excessively cold and sunless. Yet the female usually does not ovulate until April. Lack (1946) and Lack and Silva (1949) observed that at the time young Robins hatched the woods became full of food in the form of caterpillars. After the hard winter and subsequent abnormal sunshine of 1946–47, two broods that appeared before the bulk of the caterpillar harvest died "much below weight after a few days." In Oxford woods the leaves swarm with these caterpillars; and certain other species of birds which use them for their young also ovulate in time to take advantage of the harvest which ends in pupation about 12

June, plus or minus some days according to seasonal vagaries (John Gibb, personal communication). Species that feed on adult insects breed later. It seems certain that as the ecology of more species of birds is worked out in detail it will be discovered that a great number of them have cycles so timed that the incubation period ends when large amounts of animal food for the young are most easily obtainable. It is probably very significant that the various British birds that occasionally breed successfully in winter—e.g., the Wood Pigeon, Stock Dove, Robin, Blackbird, House Sparrow and Starling—get much of their food from human sources and have therefore become partially independent of the natural supply.

In many cases it may be found that the factors that time the production of the food also influence the sexual cycle of the potential breeders. These complex ecological relationships, including especially display and other behavioural interactions, present an exciting challenge to zoölogists of the future. It is clear that each vertebrate has its reproductive rhythm "anchored" in time by stimuli and inhibitors that are various and highly specific (Marshall, 1947). These will be determined only by the collaboration of workers in both laboratory and field. Both spheres of labour are equally important.

Summary

The refractory period in the testis cycle of seasonal male birds is that during which the seminiferous tubules are in a state of post-spermatogenetic lipoidal metamorphosis and before the newly-regenerated Leydig cells of the interstitium have become sufficiently mature and lipoidal to respond to neurohormonal influences initiated by environmental factors.

At the termination of spermatogenesis, most of the epithelial contents of the tubules metamorphose and disintegrate. The tubules themselves become reduced in diameter and the whole testis collapses. Concurrently, the exhausted Leydig cells of the old generation (almost denuded of their cholesterol-positive lipoids during the last stages of the sexual season) disappear. A new generation now arises in the spaces between the shrunken tubules. Fibroblasts appear in great numbers and rapidly build up a new *tunica albuginea* just inside the old testis wall (which has become thin, distorted and fragile). Thus, the period of testis collapse is also one of rehabilitation and not merely a "regression." *Postnuptial metamorphosis* is a more suitable term. The period during which the above profound changes take place is one of sexual quiescence. It is also the period of the postnuptial moult.

In late summer and autumn, after testis reorganization has proceeded to some degree and while the tubule lipoids are disappearing and the new interstitium is becoming lipoidal, many species have a characteristic postnuptial display. This behaviour seems to be initiated by events within the testis cycle. Environmental stimuli (including interactions between the sexes) may sometimes lead to a second reproduction when light is decreasing in duration and intensity.

It is known that the sexual cycles of some species are carried forward by sunshine and depressed by its absence. After their postnuptial metamorphosis, birds that have evolved a neurohormonal response to sunshine will respond sexually to candle and electric light—hence the ancient practices of *yogai* and *muit*, as well as some results of recent experimental photostimulation. While it is not denied that day-length *per se* may be partly influential in the timing of the breeding seasons of some temperate zone species, more refined techniques than those used in the past must be designed to prove it. Much photo-experimentation has been carried out under conditions that correspond but little with normal events in birds' lives. The exteroceptor/hypothalamus/pituitary/gonad mechanism of male birds may be easily jolted into activity by photostimulation, but the current theory that day-length is the most important factor in the initiation of the "spring" spermatogenesis (which often occurs at about, or shortly after, the winter solstice) is far from satisfactory.

The author believes that the internal gonad rhythm is the most important single factor in the timing of breeding seasons and the migration that is part of them. Thus, after varying periods following birth or reproduction, many species seem to be physiologically capable of reproduction. Courtship and other breeding activity is not carried forward to culmination, however, because the external environmental factors needed to bring about breeding response are lacking. Thus, certain xerophiious species breed only when it rains, irrespective of day-length, and may skip a whole year when it does not. Rainfall and its effect appear to control the breeding of many tropical species. Among temperate zone species cold and comparatively sunless and foodless winter conditions may be far more important as inhibitors than mere shortness of day *under natural conditions*. Conversely, Sooty Terns on Ascension Island breed four times every three years in an equable oceanic island environment that apparently produces sufficient food to enable the survival of young at any season.

The migratory journey to the breeding grounds (e.g., that taken by charadriiform birds that "winter" on equatorial islands) may be timed in part by a genetically fixed rate of gonad recrudescence. When the gonads of both young and adults reach a certain developmental threshold they may be then, and then only, in a condition to respond to environmental influences that stimulate the exteroceptors and anterior pituitary. Thus would the gonads become even more active, leading to behavioural reactions between the sexes, until the birds reached a condition that caused them to depart for the place where they were bred. The same may occur in migrants that "winter" in temperate zones and may partly control the breeding seasons of the many tropical birds that do not ovulate during the monsoon. It is not yet known whether the anterior pituitary, too, has a refractory phase.

After the "spring" initiation of spermatogenesis, the sexual cycles of many species are modifiable from week to week by environmental events such as

weather, food availability, and, finally, the presence of safe nesting sites. Each species has evolved its breeding response to a particular set of stimuli (including interactions between the sexes) and inhibitors. *No single over-all factor such as day-length or light-increment is responsible for the timing of avian breeding seasons. The breeding season is kept in step with the sun essentially by the external factors that permit nidification, ovulation and the survival of young on the habitual breeding ground. Of these, the most important may be a safe nesting site, mild weather, and an abundance of the food on which the young are traditionally fed.*

APPENDIX: A SIMPLIFIED TECHNIQUE FOR QUICK ROUTINE DEMONSTRATION OF INTERSTITIAL AND TUBULE LIPOIDS OF THE AVIAN GONAD

By "lipoids" are meant any of the chemically diverse fatty substances that colour with Sudan Black or Scharlach R. (Scarlet R; Sudan IV) after formalin fixation. Sudan Black was first used in cytology by Lison (1934) and its use has been recommended strongly by Baker (1944), who stresses its much greater efficacy (in comparison with Sudan III and Sudan IV) in colouring lipoids other than triglycerides. Scharlach R., which was introduced by Michaelis about fifty years ago, and Sudan Black both colour fats in a purely physical way by entering and dissolving in the lipoid globules where they are more soluble than they are in 70% alcohol or other similar vehicles. Thus they do not act in the manner of dyes, and partly because of this they show little tendency to alter the appearance of cells or their inclusions. Sudan Black is of incalculable value for detailed histochemical investigation of lipoids in that it "unmasks" certain lipoids that remain unrevealed by treatment with Sudan III or IV. But for the purpose of simple and inexpensive demonstration of the total lipoid content of the organ at different stages of its cycle the following method is recommended.

Fixation should be carried out if at all possible immediately after death, at most within two hours. Immerse the testis in formal-calcium (Baker, 1944). Commercial formalin diluted to about 5% HCHO is also adequate provided prolonged storage is not contemplated. Although formalin-penetration is fast, careful snipping, first, of the tunic of any organ more than 3 mm. in diameter is advisable. Fixation should be continued for 24 to 36 hours.

Next, the tissue should be washed in running water for at least four hours to make absolutely sure that all formalin has been removed. For most satisfactory results gelatine embedding for 24 hours at 37°C. is advised. After this the tissue and embedding medium should be chilled, *not* frozen, for a few minutes in a refrigerator. The gelatine can now be trimmed into a small block and hardened in formal-calcium (or formalin as above) for another 24 hours and washed for about 30 minutes. Then it can be cut on the freezing microtome at about 10μ.

Colouring procedure: 1. Stand sections for about 30 seconds in 70% alcohol. 2. Transfer for about three minutes to solution of Scharlach R. 3. Dip in 70% alcohol. 4. Dip in water. 5. Transfer for about three minutes to Ehrlich's haematoxylin. 6. Blue in tapwater. 7. Differentiate, if necessary, in 0.5 HCl in water. 8. Mount in Farrant's or similar medium. Slide-clips help flatten gelatine sections and express air bubbles on the hotplate.

Scharlach R. may be made up as follows: 70% alcohol, 50 mls., acetone, 50 mls., to which is added enough Scharlach R. to saturate. *Filter before use.*

The above technique, after a little practice, will bring lipoids into brilliant scarlet relief against the remaining familiar structures blued by Ehrlich's haematoxylin. The second testis, or a fragment of the first if one is damaged by shot, should be fixed in Bouin's, Flemming's, or any other good general-purpose fixative, wax-sectioned (the lipoids are now lost) and stained with Masson's trichrome or other routine method to reveal more clearly the spermatogenetic stages, Leydig cell-size and nuclear detail, and the postnuptial rehabilitation of the *tunica albuginea*. If fixation must be carried out in the field, formal-calcium or formalin is fairly satisfactory for the wax-section material as well.

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Gertrude A. Nunnemacher was born in Milwaukee, Wisconsin, on August 11, 1888. She attended public school and high school in Milwaukee and spent one year at Smith College. On February 5, 1910, she was married to Henry J. Nunnemacher. Of the six children born of this union, four are now living. All her life Mrs. Nunnemacher was deeply interested in nature. She especially enjoyed passing on to others what she had learned from her years of bird-watching in the midwest. Often she lectured about birds and led bird-walks, giving of her time and energy unselfishly. She and Mr. Nunnemacher travelled widely, in the Old World as well as the New. Wherever she went she filled notebooks with detailed accounts of her observations of plants and birds. Beginning in 1940 she and her husband made several extended visits to México, and she became much interested in the birds of that country. Shortly before her death, which occurred in the fall of 1950, she made generous gestures in support of ornithological work in México. A donation from her made possible the Crimson-collared Grosbeak frontispiece in the December, 1950, issue of the *Bulletin*. The present issue of the *Bulletin*, which has been financed by several of her friends, and by Mr. Nunnemacher, is a memorial to her interest in birds, to her special interest in México—and to her.

BIRD NOTES FROM LA JOYA DE SALAS, TAMAULIPAS

BY C. RICHARD ROBINS AND WILLIAM B. HEED[1]

THE mountain village of La Joya de Salas, Tamaulipas, is about 65 kilometers south-southwest of Ciudad Victoria, 25 kilometers south-southeast of Jaumave, 50 kilometers east-northeast of Tula, and 20 kilometers northwest of Gómez Farías. It is built around a small sink-hole lake in the center of a roughly circular valley five to seven miles across.

The valley, except for the sloping eastern part, is very flat. Its elevation probably is about 5200 to 5400 feet. Along the north, east and southeast edges small ridges and ravines lead radially to mountains which rise sharply to an elevation of at least 6500 feet (possibly considerably more). At the west rises West Mountain. At the south is a deep canyon whose bottom is about a thousand feet lower than the valley floor. Immediately beyond this canyon rise slopes as high as those to the north so that, in effect, La Joya valley is completely ringed by mountains.

Trails lead out from the valley in several directions—well defined ones to Jaumave, Tula and Gómez Farías, smaller ones to lesser villages closer by. The Gómez Farías trail leads eastward over the only ridge separating the valley from the Río Sabinas lowlands and the great coastal plain. From this trail a good side-trail leads down to Pano Ayuctle and the busy Laredo-to-Mexico City highway. The character and birdlife of the country about Gómez Farías and Pano Ayuctle already have been reported on by Sutton and Pettingill (1942. *Auk*, 59: 1–34) and Eaton and Edwards (1948. *Wilson Bulletin*, 60: 109–114).

A humid deciduous forest which has been called a 'cloud forest,' covers much of the east side of this ridge. Forest of the same sort grows in some of the ravines running out from La Joya valley. The presence of these wooded pockets and the nearness of the main 'cloud forest' explain the occasional appearance of the Crested Guan or *Ajol* (*Penelope purpurascens*), Singing Quail (*Dactylortyx thoracicus*), Ornate Eagle-Hawk (*Spizaëtus ornatus*), Bell's Warbler (*Basileuterus belli*), and Rufous-capped Atlapetes (*Atlapetes pileatus*) along the east side of the valley. All of these birds are common in the forest above Pano Ayuctle and Gómez Farías.

[1] We are indebted to J. Van Tyne and R. W. Storer, of the University of Michigan Museum of Zoology, for many kindnesses shown us; to Paul S. Martin, for leading us so ably in our field-work; to Richard B. Fischer for making prints of the photographs illustrating this paper; and to Ernest P. Edwards for lending us his La Joya field notes. We are especially grateful to George M. Sutton for helping us to plan and carry out our trip, complete our taxonomic work, and prepare this paper.

The eastern part of La Joya valley is fairly well forested with pines and moss-draped oaks. Most of the valley is, however, open and grazed to the ground, the barren monotony being relieved only by an occasional rocky outcrop or small, thorny tree. The country beyond West Mountain appears to be decidedly montane and arid. The slopes are open and rocky, with a scattering of agave and yucca, and patches of forest, presumably oak and pine. This region, the eastern edge of the great central plateau, is separated from La Joya valley, West Mountain, and, indeed, the entire Guatemalan Range of the Sierra Madre Oriental, by a large canyon. That birds we presume to be more common in this arid country to the west occasionally reach La Joya valley is indicated by the following sight records (all made by us in 1949): a group of four Say's Phoebes (*Sayornis saya*), March 25–27; a mixed flock of Bush-tits (*Psaltriparus minimus*) and Verdins (*Auriparus flaviceps*), March 24; a Sage Thrasher (*Oreoscoptes montanus*), March 24; and five Phainopeplas (*Phainopepla nitens*), May 24.

The mountains north of La Joya valley we did not investigate. Their nature is not known to us.

One more area needs to be discussed: West Mountain. The crown of this mountain was, except for a few grassy meadows, densely covered with oak-scrub knee- to waist-high except about the numerous sink-holes, where it reached 10 feet. The meadows were surrounded by aspens, cedar, and a bush resembling English boxwood. Below the very top of the mountain were depressions—each an acre or so in extent—in which grew larger oaks. These trees sometimes reached a height of 30 feet, and they were covered heavily with Spanish moss and lichens, less heavily with bromeliads and orchids. These 'oak depressions' were very different from the surrounding scrublands. On entering them we sensed the shade and a certain dampness of vegetation, soil and atmosphere. They harbored a rich avifauna. Many of the birds listed by us we encountered only in them.

In 1949 we visited La Joya from March 23 to 29 and from May 24 to 30, listing 129 bird species and collecting 82 specimens (now in the Sutton collection). Heed and Byron C. Harrell visited the valley from the evening of June 25 to the morning of June 28, collecting four specimens and adding one species to the list. (In 1948, Ernest P. Edwards, Paul S. Martin, and Roger Hurd had visited La Joya from April 11 to 14. They had collected 26 specimens and recorded two species not on our list.)

No rain fell during our March visit in 1949, and the sky was almost cloudless. Not for months had there been an appreciable shower and the lake was critically low. Because of the drouth no one had planted crops. Temperatures were, however, moderate, ranging from lows at night of 55°–60°F., to highs of about 75° in the afternoon. Between our March and May visits rain fell several times and in late May we had thunder showers. From May 24 to 30 the temperature ranged from lows of 60°–72° in the morning to highs of 71°–80° in the

afternoon. During Heed's and Harrell's visit in latter June the weather was continuously overcast and rainy.

Our La Joya list is largely of the breeding birds. The following forms seem to merit special discussion at this time:

Columba f. fasciata. Band-tailed Pigeon.

First noted May 25, when Heed collected a female, one of two birds seen near the village. On May 28, Robins found a nest (contents ?) in a large oak near a meadow on the top of West Mountain. An adult bird was on this nest, which was 20 feet up, well out on a side limb, and made of twigs, apparently, being like that of a Mourning Dove (*Zenaidura macroura*) but much bulkier. We saw hundreds of Band-tailed Pigeons along the trail between the mountain top and the village.

Rhynchopsitta terrisi. Maroon-fronted Parrot.

With George M. Sutton and Roger Hurd we made an attempt to find this species in the pines above Frank Harrison's farm, the Rancho del Cielo (between La Joya valley and Gómez Farías), on March 21, 1949. We heard the birds in the distance, but never saw them. This failure was really what prompted us to go to La Joya, for these *papagayos* were said to be common there from October to April (roughly the dry season). We heard a flock as we were climbing to La Joya on March 23, and later that day saw four flying high over the ridge east of the valley. On March 27, Robins saw a flock (50 to 100 birds) alight just out of range above him along the rim of a canyon. They were feeding on pine cones. They continued to fly back and forth over the canyon into the pines on either side. At a distance they sounded exactly like a noisy company of Acorn Woodpeckers (*Balanosphyra formicivora*), a species which breeds commonly in the region. They resembled Thick-billed Parrots (*R. pachyrhyncha*), but the red at the base of the bill was so deep (*cf.* Moore, R. T. 1947. *Proc. Biol. Soc. Washington*, 60: 27–28) that in the field it appeared to be black.

Irby Davis has commented that species of the genus *Rhynchopsitta* might properly be called macawlets. *R. terrisi* has not, so far as we know, been reported heretofore from Tamaulipas. We have no proof that it breeds near La Joya and suspect that it does not.

Hylocharis l. leucotis. White-eared Hummingbird.

On May 25 we found a nest (contents ?) of this species high on West Mountain. It was about 30 feet up in an oak, well out from the main trunk, on a twig which stuck straight down from a large horizontal branch. It was made of lichens, small bits of Spanish moss, and other plant materials, bound together with spider webs. An adult bird was on it. We would probably never have found it had we not noted the aggressive behavior of a White-eared Hummingbird which seemed to be driving all hummingbirds away from the nest-tree, returning at intervals to perch near the nest. A male specimen collected by Robins on May 27 has the measurements (wing, 55 mm.; culmen, 16) of the nominate race.

Atthis h. heloisa. Heloise's Bumblebee Hummingbird.

White-eared Hummingbirds occasionally visited flower gardens in the village of La Joya, but we found the Bumblebee Hummingbird only in the oak pockets on West Mountain. Here we saw it repeatedly May 24 to 30 and June 27. On May 27 and 28, Robins witnessed copulation several times. In each instance, the female was perched on a low bush, with her wings drooping at her sides. The male, hovering about five feet above her, moved toward her slowly. In his descent his wings appeared to beat at full speed, but as he drew close the pitch of his drone became markedly higher, as if a more rapid and less deep wing-beat were necessary to keep him from striking her. Not even momentarily did his wings stop their beating. The usual drone

of the wings is rather high-pitched and beelike and carries a considerable distance. We could identify the birds not alone by the sound of their flight but by their custom of flying along the under side of the main oak branches. Here, with wings going full speed, they moved at a rate of a few feet per second, apparently hunting food among the lichens. Occasionally a White-eared Hummingbird fed in this way, but that species seemed to prefer probing the bromeliads. The 'song' of *Atthis heloisa* was an insectlike *zeee, eeee, eeee*, each syllable rising in volume and pitch at the end. In the two specimens collected (males, May 27 and 28) the outermost primary is decidedly attenuate, and the bills measure, respectively, 12 and 12.5 mm.

Trogon m. mexicanus. Mexican Trogon.

Fairly common in wooded ravines. On May 27, at about 6000 feet on West Mountain, Robins found a nest four feet from the ground in a hole in the main trunk of a small oak. The entrance measured 4 x 2½ inches and the cavity was about an inch deep, so the two recently hatched young were readily visible. An adult male specimen (testes enlarged) collected March 27 is brassy green above, especially on the back, and not at all "blue or purplish" as Griscom (1932. *Proc. New England Zoöl. Club*, 13: 57) seemed to believe Tamaulipan birds to be.

Piculus aeruginosus. Bronzed Woodpecker.

We saw this species March 27 and 28—a single bird on each date. In May it seemed to be fairly common throughout the deciduous woodland. Robins collected a young bird (not long out of the nest, but by itself) on May 25. A little later that day he saw a family group, including three young of about the same age as the bird collected. The wide altitudinal range of this species, which has been reported only from Nuevo León, Tamaulipas, San Luis Potosí, Puebla, and northern Veracruz, is surprising.

Myiarchus tuberculifer. Dusky-capped Flycatcher.

We found this species in woodland wherever we went except near the village of La Joya. On June 27, Heed found a pair feeding young in a natural cavity in an oak about twenty feet from the ground.

Empidonax difficilis. Western Flycatcher.

Common all over West Mountain. During our May visit the birds were in pairs, and so strong was their attachment to the sink-holes in which they nested that we could easily locate the sink-holes merely by listening for the characteristic callnotes.

Catherpes m. mexicanus. Canyon Wren.

Common along the stone fences as well as about cliffs and scattered rocks. On May 26, in a small cave above the valley, we found a pair feeding young. On May 27, again in a cave, we found a nest containing four young almost ready to leave. We collected two adult males and a nestling, May 25–27.

Catharus aurantiirostris clarus. Orange-billed Nightingale-Thrush.

This bird we did not see at all in March, but in May it was the commonest species on West Mountain, especially in the oak-scrub. Although in almost constant song, it was difficult to observe because of its extreme shyness. The song, never loud, reminded us of a weak song of the Hermit Thrush (*Hylocichla guttata*). Among its various callnotes was a thin *me-aah*, reminiscent of a cry of the Catbird (*Dumetella carolinensis*); a nasal *ber-wink*; and a high squeal, audible only at close range and given near the nest.

We found ten nests, all in oaks, two to fifteen feet above the ground, on West Mountain. Six were empty, apparently just ready for eggs. One held two eggs, another three eggs (May 28), and two more probably held eggs, for a bird was sitting on each. The eggs were light green or blue-green, rather evenly spotted or blotched with lavender. The highest nests (one 12 feet up; two 15 feet up) were on sloping branches in about the sort of site a Wood Thrush (*Hylocichla mustelina*) might select. Three nests were largely of lichens, others of leaves, and all had some pine needles and moss in them.

So far as we know *C. aurantiirostris* has not before been recorded in Tamaulipas. Our three specimens (May 27–28), all males, have the pale gray under parts and not very rufescent upper parts of *clarus*.

Nest of Orange-billed Nightingale-Thrush (*Catharus aurantiirostris*) three feet above ground in scrub oak at about 6000 feet elevation above the village of La Joya de Salas, Tamaulipas, México. Photographed May 28, 1949, by William B. Heed.

Ptilogonys cinereus pallescens. Gray Silky-Flycatcher.

Not seen in March, but abundant in May on the steep hillsides, especially where weathering had bared the limestone or worn it into steplike cliffs. The birds perched on dead snags or the very tops of shrubs, darting out after insects. Their call was a hurried *chu-chup*, or a more slowly given *chup, chup, chup*. Infrequently they gave a lisping cry like that of a Cedar Waxwing (*Bombycilla cedrorum*). On May 27, several of them were carrying nest material and we found one nest—a neat, compact structure about twenty feet up on a small outer oak branch. We found several more nests on May 28 on West Mountain. Egg-laying apparently had not yet started on that date. All the nests were lichen-covered, like that described by Newman (1950. *Condor*, 52: 157–158). A male and two females collected May 26 appear to represent the not very strongly marked race *pallescens*.

Cyclarhis gujanensis. Rufous-browed Pepper-Shrike.

This species has been called a "humid forest" bird by Eaton and Edwards (1948. *Wilson Bulletin*, 60: 111), but it certainly is not restricted to the humid forest about the Rancho del Cielo or above the Río Sabinas, and it may possibly not breed there at all. We observed a singing bird well up on West Mountain in brushy, distinctly arid country. Twice we saw this bird carrying food, but when we tried to follow it to its nest we lost it among the large flocks of Abeillé's Grosbeaks (*Hesperiphona abeillei*) and numerous Gray Silky-Flycatchers.

Geothlypis nelsoni. Hooded Yellow-throat.

This shy warbler we first encountered on May 27 in the low oak-scrub on West Mountain. Here it was fairly common, though we did not find a nest. The males sang from the tops of the small oaks. The song was a distinctive *wichy wichy wichy chee chee chee chee wich* or *wichy wichy wichy bitsy bitsy bitsy brrrrr* (trilled). The note of alarm was a sharp *chip*. Occasionally one rose in air some 20 feet and gave a longer version of one of the above songs. In flight the tail appeared to be very long. Three males taken (two, May 27; one, June 27) vary considerably, one of them having no gray at all on the crown. This species has not heretofore been reported from Tamaulipas.

Tanagra e. elegantissima. Blue-hooded Euphonia.

Uncommon in March. In May abundant on the oak-covered slopes down to the very edge of the valley. It fed exclusively on mistletoe, which was common everywhere in the oaks. The males sang their loud, bubbling songs in the tops of the highest trees.

We found several nests in May—the first among the heavy leafage of a branch which had fallen from the top of an oak and lodged about 20 feet from the ground. The birds had bound the dead leaves together loosely with Spanish moss, placing the nest inside. Our climbing to this nest so disturbed the birds that they abandoned it and started another in a clump of Spanish moss in the same tree. Three other nests were all in Spanish moss. A small entrance hole led in through the moss to the nest proper, which was made of plant fibers, pine needles, and some moss. No nest examined by us held eggs, but a female taken May 26 had a well defined brood-patch and four ruptured ovarian follicles, and a female taken May 29 had a well defined brood-patch. The four males and three females collected (March and May) represent the nominate race. The females are readily identifiable as *elegantissima* because of the bright yellowish-olive tone of their under parts.

Piranga flava dextra. Hepatic Tanager.

Fairly common in higher woods. A nest, apparently just ready for eggs, we found May 28 in an oak seven feet from the ground on the top of West Mountain. It was made of plant fibers and grasses principally, with a few twigs. We collected a stub-tailed male in juvenal plumage on May 30. Three adult specimens (female, March 24; male and female, March 28) collected by Robins we have identified as *dextra*.

Pheucticus melanocephalus. Black-headed Grosbeak.

Not seen in March, but recorded often in May. Heed found a nest (three eggs) in a mesquite-like tree on a steep, brush-covered slope above the valley on May 27. The measurements (wing, 101 mm.; tail, 80; culmen, 20) of our only specimen, a male, seem to indicate intermediacy between the nominate race and *maculatus*.

Tiaris olivacea. Yellow-faced Grassquit.

To our great surprise we found this species nesting along the edges of the oak pockets at about 6300 feet elevation on West Mountain. We saw several adults on May 27 and 28,

Entrance to nest of Blue-hooded Euphonia (*Tanagra elegantissima*) in Spanish moss in an oak, fifteen feet above ground, at an elevation of about 5000 feet, near the village of La Joya de Salas, Tamaulipas, México. Photographed May 26, 1949, by William B. Heed.

one of them carrying food. We heard a young one being fed, too, but failed to find it or the nest. This species breeds rather commonly in the Río Sabinas bottomlands and along the edges of the marshes at Tampico.

Aimophila r. rufescens. Rusty Sparrow.

Heed collected one of several singing males encountered on West Mountain among oak-scrub at about 6000 feet elevation on June 27, 1949. The wing of this specimen measures 75 mm., the tail, 80. The species has not, apparently, been reported heretofore from Tamaulipas.

CONSERVATION DEPARTMENT, CORNELL UNIVERSITY, ITHACA, NEW YORK
DEPARTMENT OF ZOOLOGY, UNIVERSITY OF TEXAS, AUSTIN

NEW LIFE MEMBER

Ralph Milton Edeburn was born on a farm in Mercer County, Pennsylvania, on January 4, 1905. He received his B. S. degree from the State Teachers' College at Slippery Rock, Pennsylvania, and both his M.S. and Ph.D. degrees from Cornell. After teaching in high school for a number of years he accepted a position in the Zoology Department of Marshall College, where he now holds an Associate Professorship. He has always been interested in classroom teaching, and has devoted most of his energies to that work. He is the co-author of a laboratory manual in general Zoology for college students. His profession is pre-medical education. His interest in birds was fired many years ago by a student, and he has spent much time since collecting data on the birds of the local communities in which he has taught. At present he is particularly interested in the Nighthawk (*Chordeiles minor*) and its nesting behavior at Huntington, West Virginia. He is president of the active Huntington Bird Study Club and an associate member of the American Ornithologists' Union. He joined The Wilson Ornithological Club in 1947. He is now the Chairman of our Membership Committee. Our photo shows him holding a magpie collected by him near Huntington.

THE SAN GERONIMO SWIFT IN HONDURAS

BY MARJORIE H. CARR AND J. C. DICKINSON, JR.

THE beautiful, but little known, San Gerónimo Swift (*Panyptila sancti-hieronymi*) has long been considered to have a very restricted range. Partly because it has been difficult to collect, it has been poorly represented in collections both in this country and abroad. In the British Museum are the type pair, taken in 1862, and a third specimen, obtained in 1888 and labelled "Guatemala. J. Rodriguez. B. M. Reg. No. 1888. 7. 30. 75." Two specimens mentioned by Ridgway (1911. *Bull. U. S. Natl. Mus.*, 50: 592) are in the collection of the U. S. National Museum. They were taken at the type locality, San Gerónimo, Vera Paz, Guatemala, by Henry Hague, in 1867. Salvin and Godman (1893. Biologia Centrali-Americana. Aves, 2: 372) discuss a sixth specimen, a bird taken near Antigua, Guatemala, by Don Vicente Constancia. This specimen, which was deposited in the Museum of the Sociedad Económica de Guatemala, was destroyed in the earthquake which wrecked Guatemala City in 1925. For a long time the species thus was known from a total of six specimens and from a very few published accounts of birds seen. Notable among the sight records were those of A. W. Anthony, whose manuscript comments were quoted in full by Griscom (1932. "Bird-Life in Guatemala." *Bull. Am. Mus. Nat. Hist.*, 64: 193). Anthony saw flocks of the swifts repeatedly in May on the eastern slopes of Volcán de Agua, near Antigua, Guatemala. In the absence of specimens or records from elsewhere the range of *Panyptila sancti-hieronymi* has been believed to be restricted to the "mountains of western Guatemala" (*cf.* Peters, Check-List of Birds of the World, 4: 253). Griscom, in a recent letter to J. Van Tyne, stated that he and W. DeWitt Miller were sure they had seen the species in the mountains of north-central Nicaragua in April, 1917. They did not, however, obtain a specimen.

In the light of the paucity of definite information concerning this swift, a collection of them made recently at the Escuela Agrícola Panamericana in the republic of Honduras, Central America, is of interest if for no other reason than that it extends the known range considerably to the southward and eastward of western Guatemala. The Escuela Agrícola Panamericana is in the Yeguare River valley, in the Department of Francisco Morazán, in the mountainous south-central part of Honduras. Its altitude is 2600 feet. Field observations on the birds thereabouts were made by Carr over a period of four years. For a detailed description of the area see "Outline for a Classification of Animal Habitats in Honduras," by A. F. Carr, Jr. (1950. *Bull. Amer. Mus. Nat. Hist.*, 94: 580–585).

The large, graceful *Panyptila* was to be seen nearly any evening during the

year circling at altitudes of 4500 to 5000 feet above the mountain sides surrounding the valley. Another swift, the much smaller *Chaetura vauxi richmondi*, was observed and collected in the cloud forest capping a peak in the vicinity by Dickinson (1951. *Wilson Bulletin*, 63: 201–202). In the valley proper, *Panyptila* appeared only after the first heavy showers of the rainy season. Its descent to this lower altitude appeared to be in response to the emergence of enormous swarms of termites following the rains. At such times large numbers of San Gerónimo Swifts, in company with at least two other swifts, the Chestnut-collared (*Chaetura rutila brunneitorques*) and the Black (*Nephoecetes niger costaricensis*), as well as Barn Swallows (*Hirundo rustica*) and Violet-green Swallows (*Tachycineta thalassina*), often gathered in the valley to forage above the pastures and among the palms and buildings of the school grounds. Even at this low altitude their wariness and swift, erratic flight made collection difficult. From June 16 to July 4, 1948, we took six specimens. These have been

TABLE 1

MEASUREMENTS OF HONDURAS SPECIMENS OF *Panyptila sancti-hieronymi*

Collection*	Sex	Age	Wing	Tail	Exposed Culmen	Tarsus	Toe	Locality
UMMZ	♂	Juv.	187.0	86.5	7.0	14.5	8.0	Yeguare River
MCZ	♂	Ad.	178.5	85.7	7.5	14.0	8.1	Yeguare River
DBUF	♂	Ad.	181.0	89.0	7.0	13.7	8.1	Yeguare River
UMMZ	♀	Ad.	180.0	84.5	7.6	13.5	8.2	Yeguare River
MCZ	?	Ad.	184.0	88.5	7.7	13.9	8.0	Yeguare River
DBUF	♀	Ad.	187.0	87.5	7.5	14.0	8.0	Yeguare River
DBUF	?	Juv.	171.5	84.0	7.1	13.1	8.0	Cerro del Chile
DBUF	?	Juv.	181.0	85.6	7.2	13.5	8.4	Cerro del Chile
DBUF	?	Juv.	183.0	88.0	7.0	13.5	7.9	Cerro del Chile

* Abbreviations used are as follows: UMMZ, Museum of Zoology, University of Michigan; DBUF, Department of Biology, University of Florida; MCZ, Museum of Comparative Zoology, Harvard University.

carefully compared with specimens of the much smaller *Panyptila cayennensis*. Among the stomach contents of two specimens were the remains of large numbers of the winged form of an unidentified termite and a single adult female of the pentatomid bug *Solubea pugnax*.

We have every reason to believe that the San Gerónimo Swift breeds in the Yeguare valley. On several occasions late in the afternoon, observers saw swifts flying into an abandoned mine shaft in the precipitous scarp on the east face of Cerro Uyuca at an altitude of about 2600 feet. All attempts to reach this spot were unsuccessful. Although there were numerous such shafts at similar altitudes around the valley, this appeared to be the only one inhabited by *Panyptila*. Perhaps this was because all the other shafts were near settled areas.

We offer the following tangible proof that *Panyptila sancti-hieronymi* breeds in Honduras. On June 22, 1949, Sr. Juan Landaverde, a prospector and able woodsman from a valley some twenty miles east of the Escuela, brought to Carr three living young swifts. They were well feathered, but as yet unable to fly. They had been found by Landaverde in an old mine shaft on Cerro del Chile, Department of El Paraíso, at an altitude of about 4800 feet. Landaverde described the opening of this shaft as easily accessible. Worth noting, however, is the fact that the Chile area is wild and sparsely inhabited. The young swifts were not timid. For several days they clung to and crawled about the sides of a tall straw basket, feeding readily on yolks of eggs and mashed ripe bananas. When the basket was touched, all three usually uttered high chittering squeaks, very similar to the call of the adults, and climbed upward with mouths open and wings vibrating.

We are indebted to Dr. Pierce Brodkorb for his tentative identification of the ornithological material upon which this report is based. Dr. J. Van Tyne kindly compared our *Panyptila sancti-hieronymi* specimens with those available in the U. S. National Museum, commenting as follows: "They seem to be identical. The old skins, of course, show their age in a yellowing of the white feathers and a browning of the black ones. I noted no other differences." Dr. Van Tyne also assisted in checking collections here and abroad for additional specimens. Mr. Jon Herring furnished the identification of the insect material. Skins in the Dickinson collection have been deposited in the Museum of Comparative Zoology at Harvard University and the University of Michigan Museum of Zoology.

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CONVERGENCE IN THE COEREBIDAE

BY WILLIAM J. BEECHER[1]

EXTENSIVE efforts of the writer to find a sound anatomical basis for determining the phylogenetic relationships of passerine families leave it clear that the hazard of adaptive convergence in bird systematics has been underestimated. The present analysis of convergence in the neotropical Honey Creepers (family Coerebidae) offers evidence that this is an artificial group. It appears to be composed, in fact, of nectar-adapted warblers (Parulidae) and nectar-adapted tanagers (Thraupidae) that have evolved convergently because of similarity of diet.

The Convergence Hazard in Taxonomy

Sound systematic work in the higher categories demands sound criteria for clearly distinguishing between adaptation and phylogeny. The investigator at this level sees phylogeny through a screen of food and niche adaptations which often obscure true relationships. Such classic cases of convergence between Old and New World groups as were recently reviewed by Friedmann (1946) are obvious and constitute no hazard. But convergence between members of closely related groups occupying the same range may be such that the most expert taxonomists are unable to decide the true affinities on the basis of external characters alone (Beecher, 1950). This is no reflection on the taxonomists, who have generally been the first to recognize the problem, referring such moot groups as the Coerebidae to the comparative anatomist for additional evidence.

But internal characters are not necessarily more reliable than external ones for indicating phylogeny. They are merely additional clues, often of a very conservative sort, but sometimes capable of adaptive changes as rapid as those known for any external features. Sclater (1886: 1) long ago observed that it was "in some instances difficult to distinguish" the Coerebidae from warblers on the one hand and tanagers on the other. Lucas (1894: 299–309) made an anatomical survey of several of the most important coerebid genera; though he considered his findings confusing and inconclusive, they nevertheless confirmed an opinion many times expressed that the group needed study and was probably heterogeneous. Ridgway (1902: 377) obviously regarded the Coerebidae as close to the Parulidae and Thraupidae. He even removed the

[1] The writer is greatly indebted to the United States National Museum, the American Museum of Natural History, and the Chicago Natural History Museum for lending material. For use of specimens in their care or for information or advice, he wishes to thank Alexander Wetmore, Herbert Friedmann, John T. Zimmer, Ernst Mayr, Dean Amadon, Charles O'Brien, Josselyn Van Tyne, D. Dwight Davis, Emmet R. Blake and Melvyn A. Traylor, Jr.

genera *Conirostrum* and *Ateleodacnis* to the Parulidae, whence Lucas (1894: 309–310) had earlier removed *Certhidea*. Both Sclater (1886: 47) and Ridgway (*loc. cit.*) placed *Glossiptila* (*Euneornis*) in a monotypic subfamily under the Coerebidae. Hellmayr (1935: 218–331), however, placed all these genera, except *Certhidea*, in the Coerebidae without subfamilial distinction. Thus there has been a difference of opinion as to the status of certain genera, but a consensus that the family belongs close to the warblers and tanagers.

Convergence in the Coerebidae

It is axiomatic that a family must be erected on a basis of characters common to the included genera, and the assumption is that these characters will be fundamental, expressing a common phylogenetic origin. As pointed out by Mayr (1942: 276) and Simpson (1945: 17), any higher category must be monophyletic. The Coerebidae do not appear to satisfy these requirements.

Examining the characters of the group we find none that really distinguish it. Some species are brilliant in plumage, others dull. The bill is extremely variable—long, short, straight, curved, notched, even hooked—and this diversity of form extends to the tongue and to the head as a whole. The only feature common to all members is the adaptive trait of nectar-feeding. This trait is naturally suspect as a character if the birds involved are to be classified *according to common origin*. Lucas (1894), in attempting to determine the origins of the family, seized principally upon those features most strongly modified by the nectar-feeding adaptation—bony palate, tongue, and intestine. Ridgway (1902: 375) erred, however, when he stated that Lucas considered the Coerebidae "apparently more nearly related to the Australasian family Meliphagidae (Honey-eaters) than to the American families Mniotiltidae and Tanagridae. . . ." What Lucas did say (1894: 309) was that "the Coerebidae do not form a homogeneous group. . . ." His principal reference to the Meliphagidae (*loc. cit.*) concerned the tongue of *Certhiola*, which he believed to resemble "that of some of the Meliphagidae. . . ."

Evidence of convergence is to be obtained through a careful study of morphology, especially through study of parts of the animal not likely to be modified by the selection pressure bringing about convergence. It is well known that different parts of an animal evolve at different rates (Simpson, 1944). The hind limb is very similar in muscle pattern throughout the order Passeriformes and seems to have become relatively static after attaining a high level of general efficiency. The syringeal musculature, slightly less conservative, has served to divide this large order into suborders. But there is evidence (Beecher, 1951) that the bill and skull are still rapidly evolving in passerines—leading the way in evolution. Having dissected to date nearly a thousand specimens of oscinine birds in all families (over six hundred species), the writer finds that the more rapidly-evolving jaw muscle-patterns are clearly different for each

family. When used with the several additional lines of evidence indicated later in this paper they seem to delineate an evolutionary sequence based on adaptation to various food types.

Evidence of Convergence from Jaw Muscle-Patterns

To recognize the family differences in jaw muscle-pattern it is necessary to distinguish between two basic types of skeletal muscle—pinnate and parallel (Pfuhl, 1936). In the parallel type all fibers run the full length of the muscle and exert pull, upon contraction, directly between the points of attachment. The vireos (Vireonidae) typify this pattern (Fig. 1) with nearly the entire

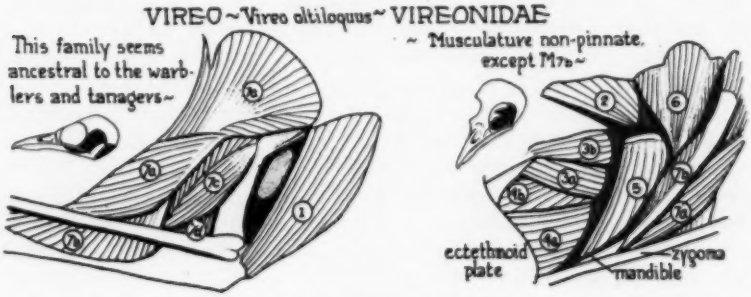

FIG. 1. Jaw muscle-pattern of *Vireo altiloquus* broken down into functional groups. In gaping, *M. depressor mandibulae* (1) depresses the lower mandible, while *M. protractor quadrati* (2) elevates the upper mandible.

The combined action of the palatine retractors 3, 4, and 5 draws the upper mandible downward. The palatine retractors are:

3. *M. pterygoideus dorsalis* (a) *anterior*; (b) *posterior*
4. *M. pterygoideus ventralis* (a) *anterior*; (b) *posterior*
5. *M. pseudotemporalis profundus*

The combined action of the mandibular adductors 6 and 7 draws the lower mandible upward. The mandibular adductors are:

6. *M. pseudotemporalis superficialis*
7. *M. adductor mandibulae* (a) *externus superficialis*; (b) *externus medialis*; (c) *externus profundus*; (d) *posterior*

jaw musculature parallel. The pinnate type is one in which the tendon or raphe runs the length of the muscle and the short fibers originate from it as the barbs originate from the shaft of a feather. The warblers show this pattern in *M. pseudotemporalis superficialis* (*6*) *and M. adductor mandibulae externus superficialis* (*7a*) as seen in Figure 2 (*Oporornis*). Grant (1942: 384) has pointed out that such a muscle is more efficient, having "a much greater functional cross section for its bulk."

It has appeared to the writer, on the basis of both skull structure and parallel

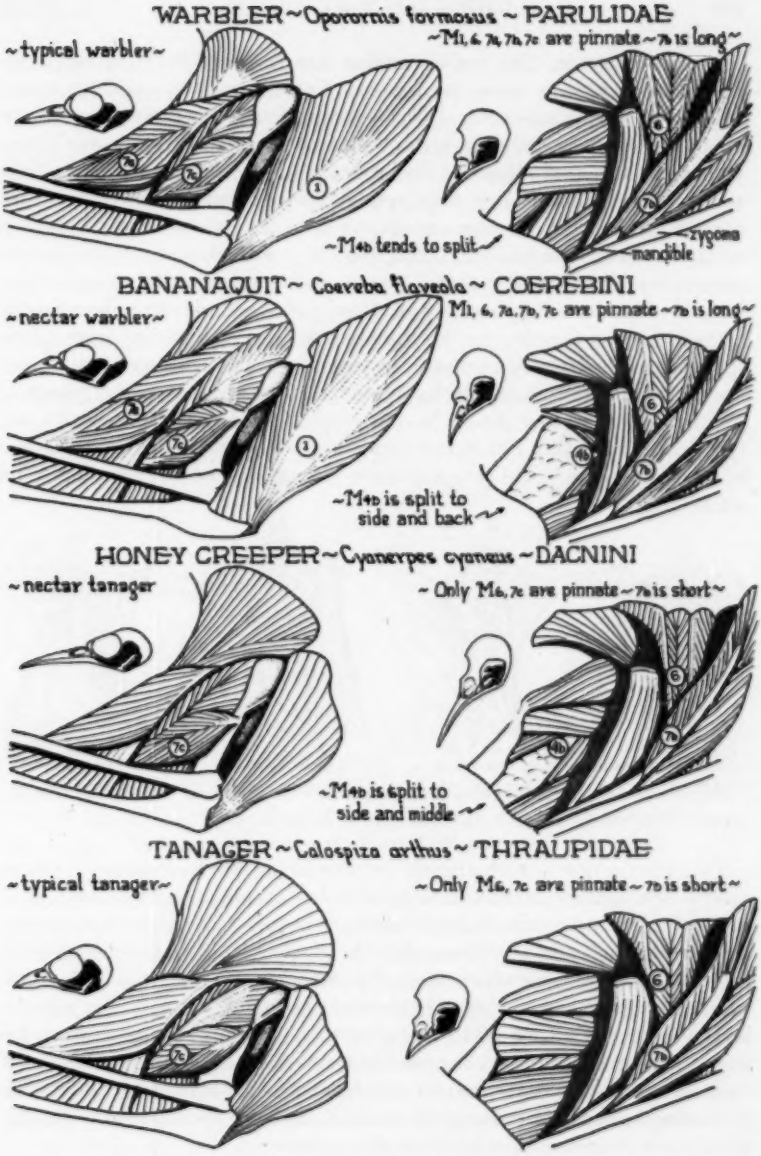
WARBLER ~ Oporornis formosus ~ PARULIDAE
~typical warbler~
~M1, 6, 7a, 7b, 7c are pinnate ~ 7b is long~
~M4b tends to split~
zygoma
mandible
BANANAQUIT ~ Coereba flaveola ~ COEREBINI
~nectar warbler~
M1, 6, 7a, 7b, 7c are pinnate ~7b is long~
~M4b is split to side and back~
HONEY CREEPER ~ Cyanerpes cyaneus ~ DACNINI
~nectar tanager
~ Only M6, 7c are pinnate ~ 7b is short ~
~M4b is split to side and middle~
TANAGER ~ Calospiza arthus ~ THRAUPIDAE
~typical tanager~
~Only M6, 7c are pinnate ~ 7b is short~

FIG. 2. Comparison of jaw muscle-pattern in typical warblers (Parulidae) and tanagers (Thraupidae) with that of their nectar-adapted forms.

jaw muscle-pattern, that the Vireonidae, like the Old World Monarch flycatchers from which it stems, is composed of phylogenetically primitive insect-eaters (Beecher, unpublished). Distribution patterns suggest that such a type may have existed even prior to the origin of flowering plants in the Upper Cretaceous and that all of the nine-primaried American families stem from ancestral vireos. The lighter, more agile Parulidae appear to have arisen with pinnate adductors of less mass and greater efficiency—a more adaptable group of insect-eaters. The heavier Thraupidae—a group adapted to feed on the abundant fruit of flowering plants—appear to have arisen with somewhat less pinnate adductors. The Parulidae and Thraupidae are, in fact, to be regarded as real adaptive branches on the phylogenetic tree, each having arisen in response to intense selection pressure on the primitive insect-eaters. The importance of the huge food supply furnished by the origin of flowering plants in producing this pressure cannot be over-emphasized. Logically it should come to bear similarly on warblers and tanagers, independently producing nectar-adapted and seed-adapted groups with ever-increasing tendency toward pinnate adductors.

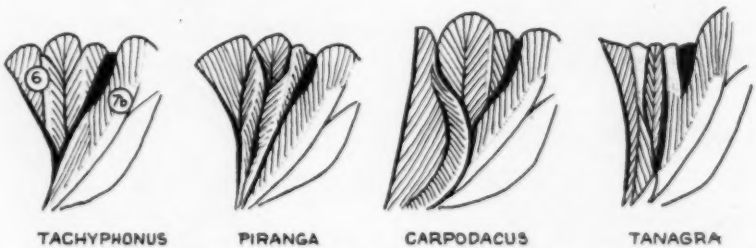

FIG. 3. An apparent shift of muscle fibers from *M7b* to *M6* (from left to right) with increased adducting power in the carduelinc line of tanagers.

To argue the question whether the increase in pinnate musculature is phylogenetic or adaptive is academic. It is both, but there is every indication that such advances in jaw muscle-pattern are conservative enough to have phylogenetic value for taxonomic diagnosis at the family level of category. The blackbird family (Icteridae) which appear to have arisen from the emberizine finches via the finch-like Cowbird, *Molothrus* (Beecher, 1951), retains pinnate adductors despite all the food adaptations and accompanying bill changes for which its genera are noted. The muscle-patterns of tanagers and warblers differ from each other and offer a sound basis for taxonomic separation; but, before presenting evidence of convergence in the Coerebidae, it is necessary to emphasize some unusual features of the Thraupidae.

This family, as outlined below, is very large and diverse. Two main lines are distinguishable, leading almost without disjunction to the finch subfamilies

Carduelinae and Richmondeninae. On the basis of jaw muscle-pattern these lines stem from a relatively primitive tanager group comprising *Calospiza*, *Thraupis* and *Ramphocelus*, of which the large genus *Calospiza* is considered by the writer to be the simplest, anatomically, and *Ramphocelus* the most advanced. The latter continues the series into the Richmondeninae in the sequence *Ramphocelus—Hemispingus—Spindalis—Saltator—Pitylus—Pheucticus —Richmondena*. This is not necessarily a direct evolutionary sequence, although it moves in the direction of increasing finch character, especially in the bill and in the heightened pinnate character of *M. adductor mandibulae externus superficialis* (*M7a*), the latter beginning in *Hemispingus* and increasing in the series. There is also good plumage agreement, especially in females, and the horny palate shows an increased tendency to develop a subsidiary lateral ridge, additional to the one so prominent in all tanagers (see *Calospiza*, Fig. 4).

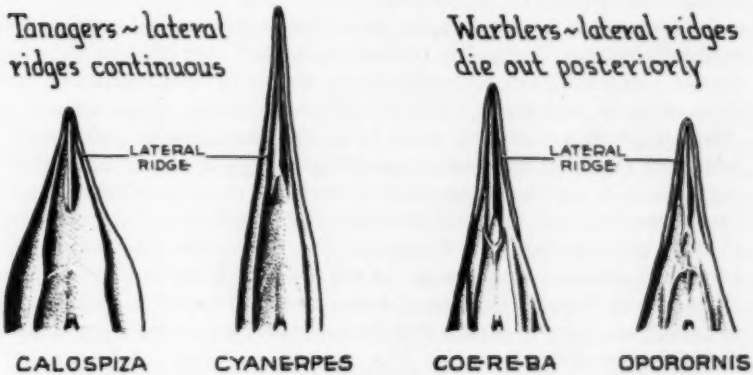

FIG. 4. Comparison of relief pattern seen in the horny palate of typical warblers (Parulidae) and tanagers (Thraupidae) with that of their nectar-adapted forms.

Ramphocelus might, because of its apparent close relationship with *Tachyphonus*, be considered a point of origin for the Carduelinae also—a group quite different in its muscular emphasis. *Tachyphonus* lies at the base of this line. The muscle-pattern of the weak-billed *T. surinamus* is like that of *Ramphocelus*, hence also of *Calospiza* (Fig. 2); but in the heavier-billed *T. rufus* the orbital slip of *M. adductor mandibulae* (*M7b*) is pinnate (Fig. 3). This appears to be correlated with increased adducting power, but with still further increase in the series *Tachyphonus—Piranga—Habia—Tanagra—Chlorophonia—Stephanophorus—Carpodacus* (Fig. 3) there appears to be a shift in emphasis from *M7b* to *M6*. The series terminates in the tremendous forward advance of the latter in *Carpodacus*, which is typical for the Carduelinae as a whole. That this shift involves a transfer of fibers to *M6* is suggested in the sketch of these two mus-

cles for *Tanagra chlorotica* (Fig. 3), where transfer seems to be taking place. The horny palate in this series agrees closely with that of *Calospiza* (Fig. 4), and plumage generally supports the thesis of close relationship.

This digression on the complexities of the Thraupidae is necessary. In no other of the sixty-odd oscinine families do such variations in the muscle-pattern occur. It points up the peculiar fact that the richmondenine finches arise so uninterruptedly out of the tanagers that ornithologists have had to draw the dividing line between the two groups arbitrarily. Now we find the carduelinе ("Old World") finches arising also without disjunction from another line of tanagers. *Chlorophonia cyanea*, with a muscle-pattern like that of *Carpodacus*, has a flattened tanager bill. The horny palate of *Stephanophorus diadematus*, a form internally almost identical with *Carpodacus*, has crenulated lateral ridges like those of the plant cutter *Phytotoma*—a further adaptation for bud-eating, so common in the Carduelinae.

Apparently it will be necessary to declare these two groups of tanager-finches subfamilies of the Thraupidae, maintaining another subfamily for the more typical tanagers. It would hardly do to extend the Richmondeninae and Carduelinae to include the two generic series cited above as stemming from *Ramphocelus*. Such a grouping would be as arbitrary as the one currently followed and the writer contemplates no change other than the including of the finch groups in the Thraupidae. But it is necessary to recognize that the anatomical modifications terminating in these finch groups have their roots deep in the typical tanagers, the Thraupinae. For this reason the basic muscle-pattern for tanagers is regarded by the writer as that found only in *Calospiza*, *Thraupis* and *Ramphocelus*, though genera not yet dissected by him may be included later. It is this pattern that the writer uses in his present re-examination of the Coerebidae.

A survey of the Vireonidae, here considered as ancestral to both the Parulidae and Thraupidae, reveals a muscle-pattern that is notably non-pinnate. In *Vireo altiloquus* and *V. olivaceus* a suggestion of pinnate character appears in *M. adductor mandibulae externus medialis* (*M7b* in Fig. 1), and this muscle, along with *M7a*, *c*, and *M6*, becomes fully pinnate in the shrike-like *Cyclarhis* and *Smaragdolanius*. But *Vireo griseus* and *V. flavifrons* lack this suggestion, as do *Hylophilus olivaceus*, *H. hypoxanthus* and *H. decurtatus*. This muscle is short and non-pinnate in the basic muscle-pattern for tanagers such as *Calospiza* but is always long and pinnate in such warblers as *Oporornis* (Fig. 2), *Setophaga*, *Basileuterus*, *Myioborus*, *Granatellus*, *Dendroica*, *Protonotaria*, *Geothlypis*, *Parula*, *Seiurus*, *Mniotilta* and *Icteria*. Thus we see a segregation on the basis of *M7b* that is diagnostic of warblers and tanagers.

Warblers differ from the basic tanagers in having a far more pinnate muscle-pattern, this in spite of the fact that they have much more slender bills and much lighter muscle mass. The pattern seen in *Oporornis* is typical. Pinnate muscles are *M. depressor mandibulae* (*M1*), *M. pseudotemporalis superficialis*

(*M6*), and three slips of *M. adductor mandibulae*, viz., *externus superficialis* (*M7a*), *externus medialis* (*M7b*), and *externus profundus* (*M7c*). In the basic tanagers only *M6* and *M7c* are pinnate. *M. depressor mandibulae* (*M1*) is always more highly developed in warblers than in tanagers (Fig. 2).

It was at first puzzling to find both tanager and warbler muscle-patterns appearing in different members of the family Coerebidae. The jaw muscle-pattern of *Coereba flaveola* (Fig. 2) corresponds perfectly, in fact, with that of *Oporornis formosus*, a typical warbler, while that of *Cyanerpes cyaneus* corresponds perfectly with that of *Calospiza arthus*, a typical tanager. It is true that *Coereba* and *Cyanerpes*, in adaptation to nectar-feeding, have an enlarged palatine salivary gland which causes the insertion of *M. pterygoideus ventralis posterior* (*M4b*) to split into two slips. Even here, however, the manner of the muscle's division is different: in *Coereba* it is split laterally and posteriorly—in *Cyanerpes*, laterally and medially. That this is not simply coincidental is borne out by the fact that, wherever this muscle is split by an enlarged palatine gland in coerebid genera, the disposal of the divided slips is either as in *Coereba* or as in *Cyanerpes*. Intermediate arrangements do not occur.

On the basis of muscle-pattern, then, it would appear that *Coereba* is nothing but a nectar-adapted warbler, and *Cyanerpes* a nectar-adapted tanager. The differences in muscle-pattern and -arrangement may be interpreted as the slightly different ways of achieving the same adaptation by two slightly different, converging stocks. Confidence in this interpretation is encouraged by the fact that a complete and sharp dichotomy of the Coerebidae is possible on the basis of the above differences. Those members which appear to be warblers are *Coereba*, *Conirostrum* and *Ateleodacnis*. Those which appear to be tanagers are *Cyanerpes*, *Chlorophanes*, *Iridophanes*, *Diglossa*, *Hemidacnis*, *Dacnis* and *Euneornis*.

Evidence of Convergence from Plumage Pattern

The writer has not examined *Xenodacnis* or *Oreomanes*, but he presumes them to be nectar-adapted tanagers. Such a presumption is plausible because the suggested dichotomy of coerebid genera is supported by plumage differences. *Coereba*, *Conirostrum* and *Ateleodacnis* have a warbler type of plumage, the other genera a tanager type of plumage, most of them with the same iridescent blues and greens observable in *Calospiza*, a few tending toward the plumbeous blues of *Thraupis*. The bizarre bill of *Diglossa* and unique tongue of *Euneornis* might cast doubt on this simple picture but the division is supported by muscle-pattern and the relief pattern of the horny palate. Moreover, there is no reason to think either that a single warbler genus and a single tanager genus gave rise to nectar-adapted warblers and tanagers, or that the nectar-adapted forms are all equally adapted to the same flowers. As will be shown beyond, the adaptation has apparently occurred in far-removed cases (*Hylophilus poicilotis* is a nectar-adapted vireo that escaped inclusion in the Coerebidae) and

it is partially achieved in warblers and tanagers never included in the Coerebidae.

Regarding the reliability of plumage as an indicator of relationship, studies of the American orioles (Beecher, 1950) show that species are not generally under strong selection pressure to change plumage pattern once this pattern has reached a state of adaptive adjustment to the environment. If the environment changes greatly, plumage tends to evolve rapidly in re-adjustment. Applying this to the present group, there appears to be no reason why tanagers taking up nectar-feeding should change the plumage facies drastically. Since they have not, despite structural changes in the head region accompanying diet specialization, changed their environmental niche, there is no reason for expecting this plumage to change much. The same applies to nectar-specialized warblers: they may logically be expected to retain warbler plumage patterns. Only when change in feeding habit requires change in habitat, as in the derivation of buntings (Emberizinae) from the Parulidae, may rapid and drastic plumage changes be expected.

Evidence of Convergence from the Horny Palate

Sushkin (1927: 3) was impressed with the value of the relief pattern of the horny palate in diagnosing large groups. This character, not to be confused with the bony palate as seen in cleaned skulls, is apparent in the roof of the upper mandible of bird skins prepared with the bill open or in alcoholic specimens. As shown in Figure 4, there are three distinct ridges on the horny palate of both warblers and tanagers, and the differential emphasis on these in the two groups permits separation of their convergent representatives in the Coerebidae. In tanagers and their nectar-adapted forms the lateral ridges are strongly emphasized and continuous to the back of the tomium, whereas in warblers and their nectar-adapted forms they are little emphasized and die out posteriorly. The palate, posterior to the central ridge, is flat and virtually without relief in tanagers, vaulted and sculptured in warblers. These features, especially the condition of the lateral ridges, are diagnostic of warblers and tanagers and support the same dichotomy of coerebid genera as has been indicated above by muscle-pattern and plumage.

Evidence of Convergence from the Tongue

If more than one warbler genus and more than one tanager genus evolve nectar-adapted forms, and if these in turn are specialized for particular flower types rather than for all flowers, convergent overlap of bills and tongues is to be anticipated. It is clear that diagnostic distinctions in external bill structure do not occur among the warblers and tanagers feeding on nectar, even though the horny palate and muscle-pattern have in each case passed through this adaptation without loss of their basic characters. In the tongue, which varies considerably even among closely related species of warblers, we should expect

least of all to find conservatism, particularly if there are special adaptations for special kinds of flowers. Here, in fact, we find the least satisfactory means for distinguishing between nectar-adapted warblers and nectar-adapted tanagers because basic distinctions are apparently obliterated by convergent "overlap" of these too-plastic characters.

In general the Hawaiian Drepanididae,[2] which are almost certainly of tanager origin (Beecher, unpublished), have progressed farther in tongue modification than any coerebid genus. As Lucas (1894: 306) has observed, the tongues of *Himatione*, *Hemignathus* and *Vestiaria* are perfectly tubular, the fimbriated edges actually overlapping. If the bifid tongues of *Cyanerpes* and *Dacnis* continued to curl, instead of simply forming a highly fimbriated half-curl, the result would be the twin tubes of the *Diglossa* tongue, and this tends to draw all nectar-adapted tanagers together. But there is apparently no sound basis for completely separating the nectar-adapted warblers with their bifid tongues from this broad and variable pattern. It is, however, noteworthy that the whipped out tongue of *Coereba* is remarkably similar to that of the oriole

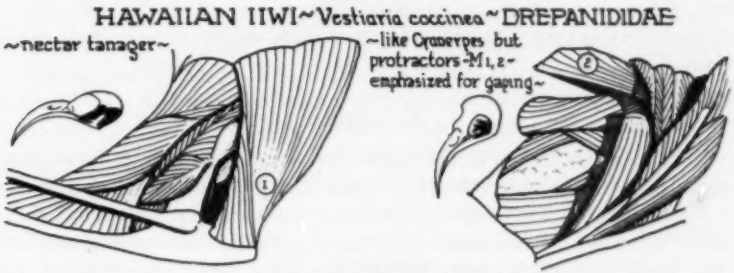

FIG. 5. Jaw muscle-pattern of *Vestiaria coccinea* of the Drepanididae, showing similarity to *Calospiza* and *Cyanerpes* despite development of *M1* and *M2* for gaping.

Bananivorus cucullatus (Beecher, 1950). Both are believed to arise from the warbler phyletic line, the emberizine finches being ancestral to the blackbirds (Icteridae), so this is apparently a case of common stock accomplishing the same adaptation twice in about the same way. The tongue of *Euneornis* is unique and, without histological sections, it is not even quite clear how it functions. But the bird is a tanager on the basis of jaw muscles and horny palate, and probably closely related to *Loxigilla*, which it resembles in these features and even in plumage pattern. Both genera occur in Jamaica, to which *Euneornis* is restricted, and it is possible that the finch *Loxigilla* arose from this tanager. Plumage change might not be expected since Gosse (1847) states that both inhabit the same niche (forest) there.

[2] Spelled also Drepaniidae and Drepanidae. See review of Amadon's "The Hawaiian Honeycreepers (Aves, Drepaniidae)" in this issue of the *Bulletin*, and also the comments of Ernst Mayr (1943. *Condor*, 45: 46) on the matter.—Editors.

Evidence of Convergence from the Bill Notch

The bill notch is so widespread in passerines that one is forced to conclude that this is a general adaptation for grasping slippery prey and, therefore, not likely to persist in flower probers. In vireos the bill is strongly notched, its shrike-like cast reaching full expression in the tribe Cyclarhini. In tanagers, which may well have arisen from ancestral vireos, the bill is also strongly notched, becoming shrike-like in *Lanio*. But in the warblers, also apparently evolved from vireos, it is weakly notched or un-notched. In *Coereba*, *Conirostrum* and *Ateleodacnis*, here regarded as nectar-adapted warblers, the bill is warbler-like and in the nectar-adapted tanagers—*Dacnis*, *Chlorophanes*, *Cyanerpes*, *Hemidacnis* and *Euneornis*—the bill is tanager-like, generally. But in some of the latter it is doubtfully notched and there is so much individual variation that one cannot safely say a particular genus is notched or not.

Again we find adaptive overlap of too-plastic characters, susceptible to obliteration by the suspected convergence, and it is plain that the bill-notch cannot be used to segregate warblers and tanagers in the Coerebidae. In support of the view that the notch easily disappears in nectar-adapted tanagers we have the evidence that it has done so in some species of the nectar-adapted vireo, *Hylophilus*.

Discussion

Is submergence of the family Coerebidae and the assignment of its genera among the warblers and tanagers justified? Here it should be appreciated that —if both warblers and tanagers arose from vireos—the two families would no sooner have established distinctions through evolutionary divergence than they would, through adaptive convergence, have begun to lose them. The differences to be looked for will not, therefore, be very dramatic and convergent obliteration may be expected especially in the very plastic bill and tongue which fall strongly under selection pressure in nectar-feeding.

The considerable within-the-genus differences of tongues in both the Parulidae and Thraupidae (Gardner, 1925) and of tongues and bills in the Icteridae (Beecher, 1950; 1951) suggest the unreliability of these characters. On the other hand, the constancy of the jaw muscle-pattern in the Icteridae, despite great modification of bill and tongue among the genera, and the conservatism of the pattern of the horny palate, inspire confidence. The latter characters have not only permitted the linking of tanagers to richmondenine and cardueline finches but also of warblers to emberizine finches and the latter to the Icteridae. This is not the place to detail these relationships, but characters capable of retaining their essential features through such adaptive transformations of skull and bill can be used with assurance in the present problem.

It is these highly dependable characters of jaw muscle-pattern and horny palate relief that accomplish the division of the genera of the Coerebidae among

the warblers and tanagers—and this in good agreement with plumage pattern. The variable bill and tongue characters overlap adaptively. It is therefore concluded that, in view of the relatively meager diagnostic differences expected in convergent genera arising from groups as closely related as warblers and tanagers, the evidence is sufficient to justify submerging the family Coerebidae.

This seems entirely reasonable. Nectar-feeding has been acquired independently in many American passerine groups: vireos, warblers, tanagers, blackbirds and even finches—not to mention derived groups like the geospizids of the Galápagos and the drepanidids of the Hawaiian Islands. Various degrees of adaptive modification for the trait are seen, not only in the bills and tongues but also in relative development of jaw muscles. In fact two distinct mechanical adaptations may be distinguished in the nectar-feeders of the Thraupidae and Parulidae and this may be regarded as an additional diagnostic difference.

The nectar-adapted warblers are "gapers" (Beecher, 1950; 1951). As noted for *Coereba* in Figure 2, *M. depressor mandibulae* (*M1*) is highly developed in both *Conirostrum* and *Ateleodacnis*. The bill is apparently plunged into a flower closed, then opened forcefully to spread the flower parts and permit the tongue to reach the nectar—or possibly a hole is pecked in the side of a flower and enlarged in this manner. Functionally it is the same adaptation noted in the Icteridae and in the Old World Sturnidae, with a lever-like posterior extension of the mandible. In Figure 2 *Coereba* is compared with *Oporornis*, which shows the same adaptation, though not all warblers are gapers in this degree.

The Neotropical nectar-adapted tanagers are non-gapers. In none of them is *M1* more highly developed than in *Cyanerpes* (Fig. 2), and it is apparent that these species simply insert the bill into flowers and sip nectar. *Diglossa* has been observed by Moller (1931: 292) to tear a hole in the side of a tubular corolla with its short, hooked bill to get at the nectar it could not otherwise reach.

However, the tanager stock apparently can produce gapers. In the nectar-adapted drepanidids, *Vestiaria coccinea* (Fig. 5), *Himatione virens*, and *Hemignathus lucidus*, the origins of protractors *M1* and *M2* are greatly expanded for gaping in tubular corollas, and the adductors *M6* and *M7* are greatly reduced. Otherwise these birds are very similar to *Calospiza* or *Cyanerpes*. That the drepanidids have a tanager origin is supported also by the identity of muscle-patterns in the Hawaiian finch, *Psittirostra cantans*, and the cardueline finch, *Carpodacus mexicanus*. This may be interpreted as two independent origins of nearly identical finches from a common tanager ancestor.

As for *Spodiornis rusticus*, Wetmore and Phelps (1949: 378) observed that "the form of the tail and of the tongue suggest affinities with the Coerebidae, . . . the family in which P. L. Sclater originally described *Spodiornis*." The palate of *Spodiornis* suggests relationships with primitive emberizine finches

like *Phrygilus*, however, and this may be one of those rare compromises—an intermediate between nectar-adapted warbler and emberizine finch. The highly angulated commissure of nectar-feeders, correlated with forward vision, is thought to pre-adapt them for seed-cracking before the bill becomes too long.

This paper has concerned itself with the submergence of the family Coerebidae as an unnatural category and the re-assignment of its genera among the warblers and tanagers. Some ornithologists will wish to retain this family name for some part of the group. There appears to be no valid reason for so doing, though the nectar-adapted warblers might be known as the tribe Coerebini and the nectar-adapted tanagers as the tribe Dacnini.

But nectar-feeding in the American nine-primaried assemblage should not be over-emphasized. Numerous references to the sucking of fruit and flower juices by warblers and tanagers never included in the Coerebidae could be cited. In the present state of our knowledge it would be difficult to know which ones to include in these tribes—unless we settle upon the genera dealt with above for the time being. Nectar-feeding is a general trait of the Thraupidae, Parulidae, Vireonidae, Icteridae, and even the polyphletic "Fringillidae." No useful purpose is served by giving it too much recognition in the classification of these higher categories.

Summary

An attempt is made on the basis of anatomical material, to show that the neotropical Honey Creepers (Coerebidae) are an artificial group composed of nectar-adapted warblers and nectar-adapted tanagers that have become convergently similar due to similar diet. Considerable care is taken to select for comparison anatomical characters likely to have been modified but little by such convergence. This precaution is necessitated by the close relationship of the warbler and tanager families due to their apparent common origin from ancestral vireos. Evidence from jaw muscle-pattern and horny palate relief is given special weight because of the constancy of these features in other passerine families studied anatomically. Tanagers and warblers have distinctly different patterns for both characters and it has been found that a clean separation of the Coerebidae into nectar-adapted warblers and nectar-adapted tanagers is possible. This dichotomy is in good agreement with plumage differences, the latter group having tanager plumage, the former, warbler plumage. A functional difference in the manner of feeding on nectar is also in agreement with this division. Such characters as bill shape and tongue specialization overlap convergently and are unreliable.

On the basis of this analysis it is concluded that the family Coerebidae should be submerged as an unnatural group, and its genera distributed among the warblers and tanagers. The genera *Coereba*, *Conirostrum* and *Ateleodacnis* could be regarded as a nectar-specialized tribe of the Parulidae—the Coerebini. The genera *Diglossa*, *Cyanerpes*, *Chlorophanes*, *Iridophanes*, *Hemidacnis*, *Dac-*

nis and *Euneornis*, and probably also *Xenodacnis* and *Oreomanes*, could be regarded as a nectar-specialized tribe of the Thraupidae—the Dacnini.

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CHICAGO NATURAL HISTORY MUSEUM

NOTES ON BIRDS OF THE VERACRUZ COASTAL PLAIN

BY DWAIN W. WARNER AND ROBERT M. MENGEL

FROM July 15 to 21, 1942, we collected and studied birds in the Mexican State of Veracruz, mostly in the vicinity of Boca del Río, a small fishing village at the mouth of the Río Jamapa, about 20 kilometers south of the city of Veracruz. We made a few observations at other localities, mainly along the Mexico-Veracruz highway.

We were accompanied by Mrs. Warner and by John Gerber, of Mexico City. Simultaneously with our arrival, a party of four from the Agricultural and Mechanical College of Texas, students of Dr. William B. Davis, established a camp a short distance up the Río Jamapa. This group (David Donaldson, R. E. Stone, J. W. McKamy, and M. Whisenhunt) remained in the area from July 15 to 28. Dr. Davis has generously made available to us the notes and specimens secured near Boca del Río by these students.

The country about Boca del Río lies in the flat coastal plain of tropical Veracruz, the "*tierra caliente*." Though marshy, it is arid compared with the eastern slopes of the mountains 40 or 50 miles inland. Vegetation is very dense and mostly low and scrubby, but along the river grow strangling figs, tall palms, and other tropical trees.

Comparatively little ornithological work has been done along the coast of Veracruz. Most collectors have concentrated on mountainous areas farther inland, a fact apparent from even a cursory inspection of the exhaustive bibliography in "Ornithology of the Mexican State of Veracruz," the unpublished doctoral thesis (Cornell University) completed by Frederick W. Loetscher, Jr. in 1941. This work, to which we refer as "Loetscher (MS)," presumably covered all birds known to occur in Veracruz, the status of each being set forth as completely as information available at the time of writing permitted.

The following 92 species were recorded between July 15 and 28. The order and nomenclature through the Formicariidae follow Peters. For the rest of the paper, except where departures are mentioned, we have followed Cory, Hellmayr, and Conover in scientific nomenclature and order of genera and species within families; the order of families is that of Wetmore. We have taken the common names from various sources in attempting to employ the most appropriate ones available. A few suggested by George M. Sutton, who is much interested in this problem, are here used for the second time. These are marked by an asterisk. We have omitted subspecific common names altogether.

We are indebted to W. B. Davis for his afore-mentioned generosity, to Alexander Wetmore for comparing certain specimens, to George M. Sutton for many helpful suggestions, and especially to O. L. Gerber of Mexico City, who made our visit to Veracruz possible. William C. Dilger made the photograph of the Chachalacas. Finally, our thanks are due to J. Van Tyne for a critical read-

ing of the manuscript. The specimens taken by Warner and Mengel are in the Sutton collection; the rest are at the Agricultural and Mechanical College of Texas.

List of Species

Pelecanus occidentalis. Brown Pelican. We observed one July 16, and one July 17, near Boca del Río.

Phalacrocorax olivaceus mexicanus. Olivaceous Cormorant. Common along the Río Jamapa, July 16–25; 3 to 30 birds seen flying toward the ocean late each evening. A female shot by Donaldson, July 23, was not in breeding condition.

Fregata magnificens. Man-o'-war Bird. One to three seen daily, July 16–21, at Boca del Río.

Ardea herodias. Great Blue Heron. Mengel saw one July 16. The Texas party observed one on the Río Jamapa. Loetscher (MS: 187) lists no records between April and October.

Butorides virescens. Green Heron. Three or four noted daily along the Río Jamapa near the coast, July 16–21.

Florida caerulea. Little Blue Heron. We saw a few white immature birds in the wet lands near Boca del Río.

Casmerodius albus. Egret. We noted 10 to 20 daily along the Río Jamapa.

Guara alba. White Ibis. An immature female shot from a flock of 20 near the Río Jamapa, July 23 (Whisenhunt), has a few white feathers on the back and wings.

Dendrocygna autumnalis. Black-bellied Tree Duck. Mengel saw two just south of Boca del Río on July 20.

Coragyps atratus. Black Vulture. Abundant about all towns in the low country, especially on the beach where fish nets were dumped. Noted twice in western Veracruz above Jalapa, at elevations of more than 7,000 feet.

Cathartes aura. Turkey Vulture. Common about Boca del Río and the city of Veracruz, but less so than the Black Vulture.

Elanus leucurus. White-tailed Kite. On July 19 Mengel watched one flying over the marshes south of Boca del Río.

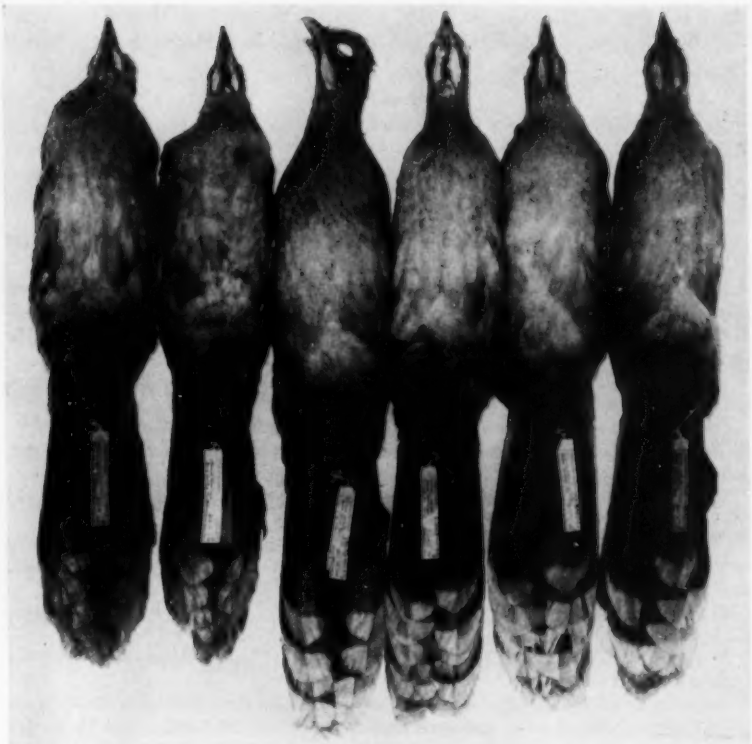
Buteo magnirostris griseocauda. Roadside Hawk.* Common in the brushy, semi-arid lands around Boca del Río. Our four specimens (males, July 16 and 18; females, July 18 and 19) are in various stages of molt. They are slightly paler, perhaps due to fading, than a small series from Tamaulipas, but typical of *griseocauda* in size.

Buteogallus a. anthracinus. Mexican Black Hawk. At dusk, on July 18, Warner took an adult female as it came to roost in coconut palms with several Black Vultures. Mengel saw two others a mile south of Boca del Río on July 20.

Polyborus cheriway. Caracara. We noted several along the Mexico-Veracruz highway, July 15, all on the low coastal plain, and a few flying over the marshes near Boca del Río, July 15–25.

Ortalis v. vetula. Chachalaca. Many of these birds inhabited the dense brush south and west of Boca del Río, where Warner took an adult male and female and saw nearly grown young on July 19. The birds called for a very short time in morning and evening, and on several occasions just after showers during the day.

The nomenclature and relationships of the Chachalacas of eastern México have attracted considerable attention recently (*cf.* Wetmore, 1943: 244–246). Since our Boca del Río specimens are virtual topotypes of *vetula* as restricted by Miller and Griscom (1921: 455), they are of particular interest. Compared with a series from southern Tamaulipas, San Luis Potosí, and northern Veracruz, they are markedly darker below and a richer olivaceous above, and the tips of the rectrices (nearly clear white in Texas and Tamaulipas birds) are dingy grayish buff. Thus they seem to belong with the southern population, further supporting use of the name *vetula* for that population. The accompanying plate illustrates these characters.



Six *Ortalis vetula* specimens from México. The two at the left, from Boca del Río, Veracruz, are *O. v. vetula*; the four at the right, from San Luis Potosí and Tamaulipas, are *O. v. mccalli*. Note, in particular, the difference in tail-tipping.

Colinus virginianus. Bob-white. Fairly common in the fields about Boca del Río. Concerning an adult female taken by Stone on July 22, Dr. Wetmore (letter: March 15, 1943) states: "It is near *Colinus v. pectoralis* but also approaches *godmani*. It differs from our two females of *pectoralis* in having definite chestnut markings on the upper back and lower hindneck, and in being paler above. Below it is like *pectoralis*."

Porphyrula martinica. Purple Gallinule. Apparently not recorded previously from Veracruz. Loetscher (MS: 956) includes it in his "Conjectural List" with the following statement: "... apparently unrecorded ... unquestionably is of regular occurrence." We saw seven or eight on July 21, at close range in marshes near the city of Veracruz, and McKamy collected a male (enlarged testes) in fresh water marshes eight kilometers southwest of the city, July 26.

Heliornis fulica. Sun-Grebe or Finfoot. Loetscher (MS: 290) lists three Veracruz localities for this bird: Río Coatzocoalcos, Buena Vista, and Isla, all in the extreme southern part of the state. Wetmore (1943: 248) states that it is "fairly common" along the Río San Agustín

below Boca San Miguel "and through the channels to . . . Tlacotalpam," and records it also from Hueyapa. Donaldson took an adult male, not in breeding condition, in the dense mangrove swamp along the Río Jamapa on July 23. Davis (1950: 379) reported this same specimen from "Boca del Río . . . July 23, 1941, in the tidal waters of the Río Moreno." The year should have read 1942. He describes the Río Moreno (letter: October 23, 1950) as a branch of the Río Atoyac, stating that the two join a short distance west of Boca del Río. He evidently overlooked Wetmore's records mentioned above. Boca del Río is about 50 miles northwest of Tlacotalpam. Mengel saw one near Boca del Río, July 16, 1942.

Jacana spinosa gymnostoma. Jacana. Fairly common in the marshes. Specimens taken at Boca del Río July 17 (male), July 18 (female), and July 20 (female). On July 27, a male was secured eight kilometers southwest of Veracruz. The gonads of all were enlarged.

Charadrius collaris. Collared Plover. Fairly common along the beach. Donaldson took a female near Boca del Río, July 18, and Mengel secured a male and female there, July 19.

Actitis macularia. Spotted Sandpiper. Mengel saw one, July 19, at the mouth of the Río Jamapa.

Erolia minutilla. Least Sandpiper. Near Boca del Río Stone collected a female on July 18, and Mengel saw two, July 19. All were in worn breeding plumage.

Sterna albifrons. Least Tern. At the mouth of the Río Jamapa, Mengel and Gerber collected a male (testes 2 × 4 mm.) from a flock of seven on July 19. This appears to be the first Least Tern to be taken in Veracruz. Dr. Wetmore has referred the specimen to *browni*, but this race is not strongly characterized and we can not help feeling that the specimen is from an eastern population.

Thalasseus m. maximus. Royal Tern. Gerber and Mengel took a female from a flock of 15 on July 19, and Stone shot a female from a flock of 25 on July 18. All were in winter plumage.

Columba flavirostris. Red-billed Pigeon. We saw from a few to over one hundred of these pigeons daily in the brushlands and mangroves near Boca del Río.

Scardafella inca. Inca Dove. Common; seen and heard frequently around Boca del Río, where Stone took a male (testes somewhat enlarged) July 21.

Columbigallina passerina. Ground Dove. Seen on several occasions at Boca del Río, but not as common as the following.

Columbigallina taípacoti rufipennis. Ruddy Ground Dove. Warner and Mengel, respectively, took a male (testes enlarged) and a female (egg in oviduct), July 16. Donaldson took a male, July 19.

Leptotila verreauxi. White-fronted Dove. Warner saw one on July 15, near the town of Rinconada just above the coastal plain, and one on July 20, near Boca del Río. Davis (1945: 275) refers specimens taken somewhat farther inland to the race *fulviventris*.

Aratinga holochlora. Green Parakeet. We noted several pairs along the Río Jamapa, July 17, and observed flocks of up to 12 birds during our stay.

Aratinga astec. Aztec Parakeet. Mengel saw two late in the evening of July 17, about a mile up the Río Jamapa from Boca del Río.

Piaya cayana thermophila. Squirrel Cuckoo. Warner saw two in heavy brush near Boca del Río, July 20, collecting one of these (molting female).

Crotophaga sulcirostris. Groove-billed Ani. Common in the brush and mangrove swamps about Boca del Río. Three males taken respectively on July 16 (Donaldson), July 18 (Donaldson), and July 20 (Mengel). The testes of all of these were somewhat enlarged.

Tapera naevia excellens. Striped Cuckoo. Mengel collected a female in badly worn plumage, July 20, just south of Boca del Río.

Tyto alba pratincola. Barn Owl. Gerber shot a female (ovary not enlarged) on July 18, at Boca del Río. Few Barn Owls have been taken in Veracruz. Davis (1945: 275) identified a female taken at Jalapa on August 6, 1942, as *guatemalae*. Brodkorb (1948: 33) identified a specimen taken June 22, 1939, at Potrero Viejo, as *pratincola*.

Glaucidium brasilianum ridgwayi. Ferruginous Pygmy Owl. Seen daily at Boca del Río, July 16–21. Its monotonous whistle could be heard most often in the evenings. Mengel took an apparently mated pair near a hole about 25 feet above ground in the trunk of a palm, July 16. Stone shot a female, July 21.

Rhinoptynx clamator. Striped Horned Owl. July 20, near Boca del Río, Mengel saw one of these owls in a thicket at such close range that he was unable to shoot. This is apparently the third published record of the species for México, the second being Brodkorb's record (1948: 33) of a specimen taken at Potrero Viejo, Veracruz, in January, 1939.

Chordeiles minor aserriensis. Nighthawk. Seen and heard every evening over Boca del Río. An immature female taken there by Stone, on July 23, has been identified by Dr. Wetmore, who says (letter of March 15, 1943): "We have only two females of this race and your specimen is not exactly like either of them; in fact it resembles in color some females of *sennetti* but differs in distinctly smaller size. This is one of the characters of the race in question [*aserriensis*] and with available material it seems proper to identify it as indicated . . ." The only race of this species listed for Veracruz by Loetscher (MS: 380) is *C. m. chapmani* (on the basis of a female collected " . . . off a nest with two eggs on the beach within sight of the city of Veracruz. This specimen, now in the Princeton Museum of Zoology, has been identified as *chapmani* by Dr. Oberholser, Mr. Rogers, and the writer . . . "). The bird referred to was collected by Charles H. Rogers on July 5, 1930. The possibility that breeding Nighthawks of this region actually belong to the race *chapmani* seems to us remote. It seems more probable that the breeding form is (1) *aserriensis* or (2) an undescribed subspecies. The breeding of *C. minor* at the city of Veracruz is surprising and constitutes a considerable extension of the known breeding range of the species.

Nyctidromus albicollis yucatanensis. Pauraque. Donaldson shot an immature male near Boca del Río, July 22.

Streptoprocne zonaris mexicana. Collared Swift. We saw several flocks near Boca del Río. Gerber shot a male and a second bird (sex?) from a flock of 20 on July 20.

Anthracothorax p. prevosti. Prevost's Mango. Mengel collected an immature male on July 16. Warner saw an adult perched on a telephone wire, July 19.

Chlorostilbon c. caniveti. Canivet's Emerald. Warner collected one at Boca del Río on July 16. It could not be sexed positively, but is very much like female specimens examined.

Amazilia yucatanensis cerviniventris. Yucatán Hummingbird. Mengel and Gerber secured male and female specimens typical of this form at Boca del Río on July 17. Warner saw others on July 16, 18, and 19.

Trogon citreolus. Citreoline Trogon. Fairly common in the mangroves and brush near Boca del Río.

Megaceryle t. torquata. Ringed Kingfisher. At least two pairs inhabited a mile-long stretch of the Río Jamapa. One pair frequented the vicinity of a clay bank just upstream from Boca del Río. Stone collected a female on July 25.

Chloroceryle amazona. Amazon Kingfisher. On July 18, Warner observed one near the clay bank referred to above.

Chloroceryle americana septentrionalis. Green Kingfisher. We saw six or eight Green Kingfishers along the Río Jamapa every day. Gerber collected a male, July 16. Females with reduced ovaries were taken July 16 and 23 (Stone).

Melanerpes aurifrons grateloupensis. Golden-fronted Woodpecker. Fairly common about Boca del Río, where a number of specimens were taken July 16 to July 19. All were molting. Dr. Wetmore has referred one of these to the present race.

Dryocopus lineatus similis. Lineated Woodpecker. Mengel collected an adult female one mile south of Boca del Río, July 20.

Dendrocopos scalaris ridgwayi. Ladder-backed Woodpecker. A juvenal-plumaged male (July 16) and a very worn adult female (July 19; reduced ovary) have been identified as *ridgwayi* by Dr. Wetmore.

Synallaxis erythrothorax furtiva. Rufous-breasted Spinetail. Heard frequently in the dense thickets near Boca del Río, but seldom seen. Warner succeeded in collecting two singing males and a worn female (with a fully formed egg in the oviduct) on July 20. These specimens are typical *furtiva*.

Thamnophilus doliatus intermedius. Mexican Ant-shrike. Common in dense brush near Boca del Río, where Warner took an adult male, July 18.

Platypsaris aglaiae sumichrasti. Rose-throated Cotinga. Common at Boca del Río. Two adult males, an immature male, and three females, although quite worn, are recognizable as this dark race.

Pyrocephalus rubinus. Vermilion Flycatcher. Recorded at Boca del Río on four occasions by the Texas party. A juvenile female taken July 17 (Whisenhunt) is not, in our opinion, subspecifically identifiable.

Tyrannus melancholicus chloronotus. Olive-backed Kingbird. Usually found with Derby and Social Flycatchers. Five adult specimens (three males, two females) secured near Boca del Río were in various stages of molt. Stone took an immature female in fresh plumage, July 17. One of our specimens, sent to Dr. Wetmore, he identified as this race.

Legatus leucophaius variegatus. Pirate Flycatcher. We took a female (wing, 92 mm.) on July 17, when two were seen. A second female (wing, 87 mm.) was secured on July 18.

Myiodynastes l. luteiventris. Sulphur-bellied Flycatcher. Seen at Boca del Río July 16, 18, and 19. Warner collected a male on July 17.

Myiozetetes similis texensis. Social Flycatcher. Common at Boca del Río. Warner took a female there, July 16.

Pitangus sulphuratus guatemalensis. Derby Flycatcher. Common along the Río Jamapa near Boca del Río. We saw several nests, some of them apparently occupied, and two newly fledged young. Concerning a male (July 16) and female (July 18) taken at Boca del Río, Wetmore has written (letter: December 8, 1947): "... definitely intermediate but appear closer to *guatemalensis*. They agree with this form in extent of white on the forehead. Below they are paler colored, like *texanus*, but I believe that this lighter color is due in part at least to fading ...."

Myiarchus tyrannulus nelsoni. Mexican Crested Flycatcher. According to Loetscher (MS: 540) this species has not been recorded as breeding in Veracruz. He gives only six records for the state. We found it common at Boca del Río. Ten specimens, all in very worn plumage and with gonads of moderate size, were collected by the two parties.

Elaenia flavogaster subpagana. Yellow-bellied Elaenia. Warner saw a single individual in the town of Boca del Río, July 16. Mengel took a female there July 17.

Camptostoma imberbe. Beardless Flycatcher. Mengel saw one on July 16, just west of Boca del Río.

Progne c. chalybea. Gray-breasted Martin. Common near Boca del Río. Male collected July 17 (Mengel).

Iridoprocne a. albilinea. Mangrove Swallow. Common at Boca del Río. Male collected July 17 (Mengel).

Psilorhinus m. morio. Brown Jay. Seen at Boca del Río July 16, 18, and 20. McKamy took a female of this race on July 21.

Campylorhynchus z. zonatus. Banded Cactus Wren. Groups of from three to five encountered frequently in palms near Boca del Río. We took males July 16 and 18, and McKamy collected another, July 20.

Campylorhynchus r. rufinucha. Rufous-naped Cactus Wren. Although this wren was less common than the preceding species, we saw it almost daily in the more open areas about Boca del Río, where we took a juvenal-plumaged male on July 20. Mengel collected an adult on July 15, near Rinconada, just above the coastal plain.

Pheugopedius m. maculipectus. Spotted-breasted Wren. Quite common in the low, dense growth around Boca del Río. Warner and Mengel each collected a singing male on July 18.

See Wetmore (1943: 300) for the name used here.

Turdus grayi tamaulipensis. Gray's Robin. Seen several times July 16–20. A female taken at Boca del Río on July 16 (Warner) is intermediate in coloration of underparts, but much closer to *tamaulipensis* than to *grayi*.

Polioptila c. caerulea. Blue-gray Gnatcatcher. Warner saw three gnatcatchers at Boca del Río on July 20. A female (?) specimen he secured that day we have called *caerulea* on the basis of size (wing, 50 mm.) and coloration.

Vireo olivaceus flavoviridis. Red-eyed Vireo. Two males taken respectively on July 16 (Warner) and July 20 (Donaldson) at Boca del Río. We agree with Sutton, Lea, and Edwards (1950: 53–54) that *olivaceus* and *flavoviridis* are conspecific.

Dendroica petechia bryanti. Yellow Warbler. According to Loetscher (MS: 739) a specimen taken by Fuertes at Tamiahua Lake in extreme northern Veracruz on April 16, 1910, is the only one "... undoubtedly taken within the state which the writer has seen." This specimen, now at Cornell University (No. 16180), is labelled female. We took single females at Boca del Río on July 17 (Mengel) and July 20 (Warner). These are in fresh fall plumage. One is much yellower than the other. We saw other individuals on July 17, 19 (two), and 20.

Chamaethlypis poliocephala palpebralis. Thick-billed Yellow-throat.* Common and singing constantly. Our two groups collected seven specimens, all males with enlarged testes, in the marshes near Boca del Río, July 16–22.

Amblycercus holosericeus. Yellow-billed Cacique. We saw one close to the Mexico-Veracruz highway near Rinconada, July 15.

Tangavius a. aeneus. Red-eyed Cowbird. The Texas party saw several small flocks at Boca del Río and collected two adult males (one with enlarged testes).

Cassidix m. mexicanus. Great-tailed Grackle. One of the most abundant birds along the Río Jamapa. Warner shot a female (ovary reduced) July 18, and Donaldson took a male (testes enlarged) July 16.

Dives d. dives. Sumichrast's Blackbird. Six specimens taken near Boca del Río July 18–27. One of these (July 18) was a male in juvenal plumage (Donaldson).

Icterus spurius. Orchard Oriole. Warner took a molting immature male, July 16. We saw three others the same day, two immature males and one presumed to be a female. Mengel saw three on July 17, and McKamy collected an adult male (testes reduced), July 18.

Icterus prosthemelas. Black-cowled Oriole.* Mengel took a molting male, July 18, and Warner saw one on July 20. Loetscher (MS: 805) regards this species as rather rare in Veracruz.

Icterus m. mesomelas. Yellow-tailed Oriole. Noted once, when Stone took an adult female in worn plumage, July 21.

Icterus g. graduacauda. Black-headed Oriole. Recorded once: a female in worn plumage shot on July 18 (McKamy). According to Loetscher (MS: 809) this bird is rare on the coastal plain.

Icterus gularis tamaulipensis. Black-throated Oriole.* Common in the vicinity of Veracruz City and Boca del Río. Gerber, McKamy, and Whisenhunt secured specimens, July 16 and 18. We saw a number of nests, and the Texas party observed two young just out of the nest.

Agelaius phoeniceus richmondi. Red-wing. Common along the lower reaches of the Río Jamapa and in the coastal marshes near the city of Veracruz. Five males and a female collected. We saw young being fed on July 18.

Thraupis episcopus diaconus. Blue-gray Tanager. Rather common in the vicinity of Boca del Río, although Wetmore (1943: 327) did not find it common at Tres Zapotes. Our two parties took two males and four females, July 16–20. We suggest that the common name used here is more appropriate than "Gray Tanager" or "Blue Tanager"—names previously applied to the species.

Thraupis abbas. Yellow-winged Tanager. Fairly common near Boca del Río, where we saw individuals and small groups every day. Gerber and Warner took two immature specimens, July 16 and 17, respectively. Whisenhunt collected a female (molting) on July 19.

Saltator coerulescens grandis. Gray Saltator. Common in brushy fields. Daily we heard its clear, whistled song which was suggestive of a Cardinal's. Two males secured: July 16 (Warner); July 17 (Mengel).

Richmondena cardinalis coccinea. Jalapa Cardinal. Moderately numerous along edges of fields near Boca del Río. Warner, Mengel, and Donaldson took three males, July 18–20.

Passerina v. versicolor. Varied Bunting. According to Loetscher (MS: 883–884), the only records for Veracruz are "unsatisfactory" ones from Orizaba and Jalapa. Mengel took a singing male (testes enlarged) on July 15, near Rinconada, just inland from the coastal plain. Davis (1945: 285) and Brodkorb (1948: 38) have reported specimens from the state.

Passerina ciris pallidior. Painted Bunting. Loetscher (MS: 884) lists this bird as "a rather common transient and winter visitant." He gives no spring date later than May 5 and states that fall arrival dates are lacking. Warner took an adult male (testes somewhat enlarged) one mile north of Boca del Río, July 20 (wing, worn, 74 mm.; tail, worn, 56).

Sporophila torqueola morelleti. Collared Seedeater. One of the most numerous birds at Boca del Río, where it sang throughout each day in the brush. Mengel shot a male, July 20. Whisenhunt, Stone, and McKamy collected two males and a female, July 17–19.

Volatinia jacarina splendens. Blue-black Grassquit. Quite common near Boca del Río: three males taken there—July 16 and 18 (Whisenhunt); July 18 (Warner). Stone took one eight kilometers southwest of the city of Veracruz on July 26.

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THE TRACHEA OF THE HOODED MERGANSER

INCLUDING A COMPARISON WITH THE TRACHEAE OF CERTAIN OTHER MERGANSERS

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AMONG the many gaps in our knowledge of the Anatidae, as pointed out by Delacour and Mayr (1945: 34), are those regarding the tracheae of certain species. The following description of the trachea of the Hooded Merganser (*Lophodytes cucullatus*) will supplement both the first account written by William MacGillivray (1852: 227) and a later brief account by John C. Phillips (1926: 249).

Prepared, unstretched adult male Hooded Merganser tracheae used in this study had an overall length (including the tympanum) of 102 to 138 mm. This wide variation is at least partly the result of using both alcoholic and dried specimens for measurement. A dried trachea is shorter. (This is very likely because of shrinkage caused by the disappearance of the membrane between the osseous rings.) Even when measuring fresh material, a variation in results is possible. For example, one fresh female trachea when relaxed measured 110 mm., but when stretched to its fullest measured 155 mm. However, measurements of the bony part of the structure are not affected by this shrinkage and consequently show only slight variation. Furthermore, it is to be remembered that discrepancies in total length measurements found in the literature may be the result of age differences; of the condition of the specimen—whether fresh, alcoholic, or dry; and/or of differences in measuring technique (i.e., overall length measurements may have been based on either a fully extended or a contracted trachea).

For about three-quarters of its length the diameter of the tube in the male Hooded Merganser varies little from $\frac{3}{16}$ of an inch (5 mm.). At the commencement of its lower quarter it flattens and dilates to a width of about $\frac{1}{2}$ inch (12 mm.). Joined to this enlargement by a short length of tube is an asymmetrical, irregularly-shaped tympanum, a hollow, bony structure about as wide as long, possessing two openings on the ventral and one on the dorsal side, each covered by a tight membrane. The major protuberance (or chamber) is on the left side. Two bronchi arise from the posterodorsal edge.

The tracheal rings are of several kinds. Most of those in the upper third of the tube are complete and nearly uniform in width. All are of osseous tissue and have little membrane between them. Those of the middle third also are bony; some are complete, but most of them are tapered at the ends, and by a

[1] The writer is greatly indebted to F. H. Kortright, E. B. Chamberlain, Jr., Philip Humphrey, and the Royal Ontario Museum of Zoology for furnishing the material on which this description is based.

regular staggered arrangement produce an interlocking or shingled effect. There is very little membrane between these rings. The rings of the dilated, lower third of the tube are tapered, staggered, and quite variable in width. They are osseous on the ventral side but completely membranous on the dorsal side. The approximately ten bony rings which connect the enlarged portion of the tube with the tympanum are of peculiar structure. On the dorsal side they are flat and somewhat tapered in width. On the ventral side, each ring becomes extremely narrow and rises to a small peak in the center. The 'peaks' of eight of the ten rings form an acute midline carina. Membrane separates each of these narrow rings ventrally.

Table 1 presents data on the tracheae of four male Hooded Mergansers.

The measurements of the tracheae of female Hooded Mergansers were from

TABLE 1

TRACHEAL MEASUREMENTS IN MILLIMETERS OF FOUR MALE HOODED MERGANSERS

	1 (dried)	2 (dried)	3 (alcoholic)	4 (alcoholic)
Overall length, dorsal, from posterior edge of glottis to posterior edge of tympanum	—	89	98	124
Overall length, ventral, from posterior edge of glottis to posterior edge of tympanum	—	102	109	138
Diameter at base of glottis	6	6	6	6
Diameter at narrowest part of tube	4	4	4	4
Diameter at beginning of dilation	6	5	5	6
Diameter between dilation and tympanum	6	5	5	6
Length of dilation	13	13	13	13
Greatest width of dilation	12	11	12	12
Length of tympanum, dorsal	10	9	9	10
Length of tympanum, ventral	22	21	21	21
Greatest width of tympanum	19	20	20	20
Length of bronchi	10	—	13	24
Diameter of bronchi at base	4	—	3	4

TABLE 2

TRACHEAL MEASUREMENTS IN MILLIMETERS OF THREE FEMALE HOODED MERGANSERS

	1 (dried)	2 (dried)	3 (fresh)
Overall length from posterior edge of glottis to posterior edge of simple tympanum	—	107	110
Diameter of tube	5	5	5
Greatest width of simple tympanum	8	8	8
Narrowest width of simple tympanum	5	5	5
Length of simple tympanum	5	5	5
Length of bronchi	13	13	13
Diameter of bronchi at base	3	3	3

one fresh and two dried specimens (Table 2). The overall length of the trachea of a female Hooded Merganser is between $4\frac{1}{4}$ (107 mm.) and $4\frac{3}{8}$ inches (110 mm.). The tube is nearly uniform in diameter, averaging $\frac{3}{16}$ of an inch (5 mm.). The tympanum is a simple, symmetrical, hollow structure, roughly trapezoidal in shape, about $\frac{3}{16}$ of an inch (5 mm.) in length, and formed by fusion of the tracheal rings. Two bronchi arise from its posterior aspect. The tracheal rings are osseous and are quite uniform in size and shape, showing little tapering.

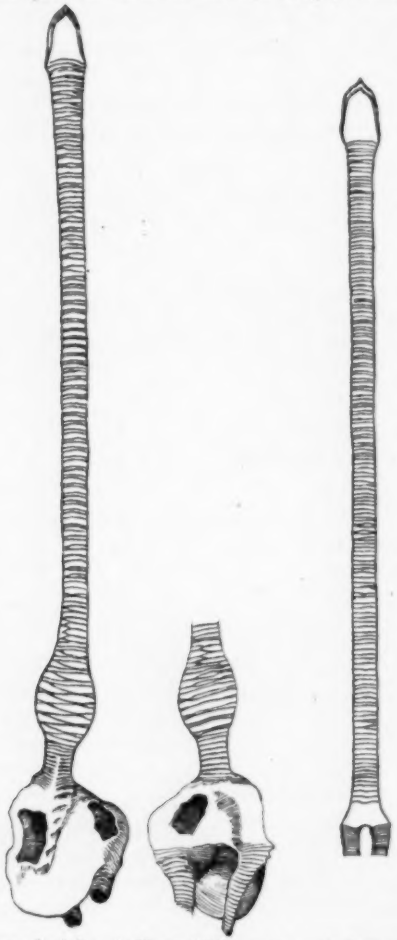

FIG. 1. Left, trachea of adult male Hooded Merganser, ventral aspect, showing tympanum at bottom. Middle, the tympanum, dorsal aspect. Right, trachea of adult female Hooded Merganser, ventral aspect. All drawings a little under natural size.

As an aid toward better understanding of the relationship of the monotypic genus *Lophodytes* to the two other genera of Mergansers (*Mergellus* and *Mergus*), a comparative review of the tracheae of *Lophodytes cucullatus*, *Mergellus albellus*, *Mergus merganser americanus*, and *Mergus serrator* is herewith presented. Measurements for these species (with the exception of the Hooded Merganser) were obtained from published accounts and/or published natural-sized drawings.

Male American Merganser (*Mergus merganser americanus*).—In the male American Merganser the trachea is 10½ inches long (Audubon, 1838: 270), 12 inches long (Yarrell, 1843: 296), or "about a foot in length, when moderately extended" (MacGillivray, 1852: 209). It is, therefore, from five to eight inches longer than in *Lophodytes cucullatus*. In the American Merganser, the tracheal tube possesses two rounded enlargements, the first (maximum width: $\frac{6}{12}$ of an inch) in the upper third of the tube, and the second (maximum width: $\frac{7}{12}$ of an inch) in the middle third of the tube. The lower third of the tube is of uniform width, with an average diameter of $\frac{3}{12}$ of an inch.

The tympana of the two species are similar in structure—both being hollow, bony, of irregular shape, with the major protuberance on the left, and possessing three membrane-covered fenestrae, one dorsal and two ventral. The greatest diameter of the tympanum of the male American Merganser is 2⅛ inches, while that of the male Hooded Merganser is $\frac{13}{16}$ of an inch. The bronchi arise from the posterior edge on the dorsal aspect nearly one inch apart in the American Merganser and about ¼ of an inch apart in the Hooded Merganser.

Female American Merganser.—The trachea of a female American Merganser is 9 inches long, or about 4¾ inches longer than that of the female Hooded Merganser. Both have tracheal tubes of uniform size: ⅛ of an inch in the American Merganser and $\frac{3}{16}$ of an inch in the Hooded Merganser. The simple tympanum formed by fusion of the lower tracheal rings is of similar shape and structure in both species. The bronchi stem from its posterior aspect, $\frac{5}{12}$ of an inch apart for the American and ⅛ of an inch apart for the Hooded Merganser.

Male Red-breasted Merganser (*Mergus serrator*).—The trachea of the male Red-breasted Merganser measures 11½ inches (Audubon, 1849: 99), or about 11 inches (MacGillivray, 1852: 218); in other words between 5½ and 7½ inches longer than that of the male Hooded Merganser. There is one enlargement just above the midpoint of the tracheal tube. This dilation is two inches long and $\frac{1}{12}$ of an inch wide. The male Hooded Merganser likewise has one dilation in the tube but this is in the lowest quarter of the tube and is ½ of an inch wide at its widest point and ½ of an inch long. In each species the diameter of the remaining portion of the tracheal tube is quite constant, being between ¼ and ⅛ of an inch wide in the Red-breasted Merganser and $\frac{3}{16}$ of an inch wide in the Hooded Merganser.

The tympanum of the male Red-breasted Merganser is irregularly heart-shaped and has a maximum diameter of two inches. In the Hooded Merganser

this structure is asymmetrical and has a maximum diameter of $\frac{1}{16}$ of an inch. According to Latham (1798: 122) and MacGillivray (1852: 218), the tympana of both species have three membrane-covered fenestrae, two ventral and one dorsal; Audubon (1849: 99) mentions but "two lateral membranous spaces." In the Red-breasted Merganser the bronchi arise $\frac{3}{4}$ of an inch apart on the posterodorsal edge of the tympanum.

Female Red-breasted Merganser.—No exact measurements of the length of the trachea were found, but since Audubon (1849: 99) states that the trachea has 150 rings, the same number as in the female American Merganser (Audubon, 1838: 270), the length is probably similar, i.e., about 9 inches long, or about $4\frac{3}{4}$ inches longer than that of the female Hooded Merganser. The tracheal tube is nearly uniform in diameter throughout and ends in a very simple symmetrical tympanum from the posterior aspect of which two bronchi arise.

Male Smew (*Mergellus albellus*).—The trachea of the male Smew is about nine inches long (Yarrell, 1843: 281; MacGillivray, 1852: 235) or from $3\frac{1}{2}$ to 5 inches longer than that of the male Hooded Merganser. The tube is narrow (about $\frac{3}{16}$ of an inch) at the anterior end, but it gradually increases to a diameter at midpoint of about $\frac{3}{8}$ of an inch, this being maintained for the rest of its length. There is no dilation.

The tympanum of the male Smew possesses, according to Latham (1798: 124), one round fenestra covered by a drum-like membrane and, on the opposite side, a smooth, oval, hollow bone which is united with the membrane. Yarrell (1843: 281) mentions "spaces in the bone supplied with tympanic membranes." MacGillivray (1852: 235) states that there are "two lateral membranes of which the posterior is largest." The drawing accompanying Bloch's paper (1779, Tab. 18, Fig. 7) seems to show but one opening. The tympanum is displaced to the left and measures $1\frac{1}{4}$ inches at its widest point and $\frac{3}{4}$ of an inch long. The bronchi arise about $\frac{1}{2}$ of an inch apart.

Female Smew.—No information was obtainable regarding the length of the female Smew's trachea, but a life-size drawing of a portion of the trachea (Yarrell, 1843: 281) shows it to be uniform in width, with a diameter of $\frac{3}{16}$ of an inch, the same as for the female Hooded Merganser. The simple tympanum measures $\frac{1}{2}$ by $\frac{3}{16}$ of an inch, that of the female Hooded Merganser $\frac{5}{16}$ by $\frac{3}{16}$ of an inch. The bronchi arise $\frac{3}{16}$ of an inch apart in the Smew.

Summary

The trachea of the male Hooded Merganser is from $3\frac{1}{2}$ to 8 inches shorter, and much narrower, than that of the male American Merganser, Red-breasted Merganser, or Smew. It possesses but one dilation, this being in the posterior quarter. The trachea of the male Red-breasted Merganser also has a single dilation, but it is much larger than in the Hooded Merganser and is just anterior to the midpoint of the trachea. In the male American Merganser there

are two dilations. In the male Smew there is none. The tympanum, which is present in the male in all four species discussed, varies in configuration and dimensions. In the Hooded Merganser it differs decidedly in proportions and in the number of fenestrae from that of the Smew; and while somewhat similar in shape and number of openings to those of the American Merganser and the Red-breasted Merganser, it is but half as large.

The trachea of the female Hooded Merganser is shorter and smaller than in the female American Merganser, Red-breasted Merganser and Smew. In all these species, however, the trachea of the female is much the same.

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SUMMER BIRDS OF AUTLAN, JALISCO

BY DALE A. ZIMMERMAN AND G. BRYAN HARRY[1]

THE city of Autlán, Jalisco, is about one hundred miles southwest of Guadalajara, and not far from the Río San Pedro. Its elevation is about 3000 feet. Mountains rise all about it—to the north and west the Sierra de Perote, to the southeast the Sierra de Autlán and the Nevado de Colima, and to the southwest lesser ridges which step down gradually to the coastal plain. The highest mountain of the region is the Nevado de Colima (elev. 14,000 feet). Autlán is only 50 miles from the Pacific.

The area immediately about Autlán is arid tropical. Its summers are hot and its winters warm. In general, precipitation is light, though occasional torrential rains in summer subject the slopes to heavy erosion. Farming is carried on only during the rainy season, for there is no irrigation. In cultivated districts fence-rows and scattered thickets provide cover for quail and other ground birds. Uncultivated areas are largely scrubland covered with an open shrubby growth of giant cacti (*Lemaireocereus*), thorny bushes, and trees of the genera *Prosopis*, *Acacia*, *Pouzolzia*, *Croton*, *Bursera*, and *Plumeria*. We refer to this habitat as "scrub forest" where the trees form a fairly dense canopy 20 to 30 feet high.

Most of the area about Autlán is heavily over-grazed. There is abundant evidence of destructive land-use. Much of the topsoil has been eroded from even the gentlest slopes, and where it has been deposited in the valleys agriculture is intensively practiced. The clumps of grasses and ground-clinging vines left by grazing animals provide refuge for numerous lizards and ground squirrels. We saw coyotes occasionally.

There are no swamps or lakes in the immediate vicinity of Autlán, but between Autlán and Guadalajara are a few marshy areas where herons and other water birds fed. We did no collecting in these marshes.

The only passable road leading southward from Autlán soon leaves the scrubland, and winds up oak-covered slopes to an elevation of about 4000 feet. We did some collecting in these oak groves nine miles south of the city. From here the road drops gradually to areas of luxuriant vegetation at 2000 feet. Twenty miles from Autlán (two miles north of the village of La Resolana), at an eleva-

[1] This paper is based on field work done from June 26 to August 7, 1949. We wish to thank H. H. Bartlett, of the University of Michigan Botanical Gardens, for financial aid; J. Van Tyne, of the University of Michigan Museum of Zoology, for ammunition; Rogers McVaugh and Robert Wilbur, of the University of Michigan Department of Botany, for assistance in identifying plants; the Dirección General Forestal y de Caza in México for a scientific collecting permit; J. L. Peters, of Harvard, for making certain comparisons for us at the Museum of Comparative Zoology; officials of the U. S. National Museum for lending specimens; and H. O. Wagner, for his interest and help.

tion of about 1500 feet, the road penetrates a dense, tropical, deciduous forest. This area is hot and humid, being subjected to daily downpours during the rainy season. Here, trees of the genera *Ficus*, *Hura*, *Calliandra*, *Enterolobium* and *Acacia* flourish. On the slopes directly above the densely wooded bottomlands *Curatella* is the dominant tree, and shrubs of the genera *Piper*, *Corchorus*, *Triumfetta*, *Tournefortia*, *Acalypha* and *Solanum* are common. Deer, coati-

Cultivated bottomland surrounded by scrub-covered slopes eight miles northeast of Autlán, Jalisco, México. Photographed August 4, 1949, by G. Bryan Harry.

mundis, and cougars are among the larger mammals of the area. Ticks and various biting and stinging insects are abundant, contributing their share to the discomforts of the country. We collected here for a week in early July and occasionally thereafter.

Harry spent 12 days (July 19–August 1) collecting in the Sierra de Autlán. His base camp there (elev. 7200 feet) was near a small mountain stream ten miles southeast of the village of Tecomatlán. Oak forests with herbaceous ground-cover are dominant in that area from 4000 to 5000 or 6000 feet. Higher still are open stands of tall pines with occasional firs, many trees being two or three feet in diameter. Beneath the pines is a ground-cover of grass, but the natives burn the slopes during the dry season. In protected moist pockets the oak forest is dense; the large trees are covered with a tangle of ferns, vines, bromeliads, mosses, and orchids. *Arbutus* trees and shrubs of the genera *Salvia*,

Cornus, and *Castilleja* grow in both sheltered and unsheltered areas. Above the pines, between 8000 and 9000 feet, there are meadows. Here lupine grows with the dense, tough clumps of waist-high bunch grass, and there is a scattering of pines and shrubbery.

Podilymbus podiceps. Pied-billed Grebe.—Noted June 23: two adults and several immature birds on a pond 30 miles northeast of Autlán.

Ardea herodias. Great Blue Heron.—One was feeding with Egrets at a roadside pond 35 miles northeast of Autlán on August 7.

Casmerodius albus. Egret.—About 65 seen in recently flooded lowlands 15 to 35 miles northeast of Autlán on August 7

Anas diazi. Mexican Duck.—On June 23 we saw two on a temporary pond in a cornfield 20 miles northeast of Autlán. We noted the greenish bill of the male and the white lines bordering the speculums.

Coragyps atratus. Black Vulture.—Common in and about Autlán (up to 4000 feet) throughout our stay. On July 15 Harry saw 40 feeding on the carcass of a cow at 4000 feet elevation. The same day, at Autlán, Zimmerman saw one being pursued by a female Great-tailed Grackle (*Cassidix mexicanus*). Largest number seen during one day: 80 (July 25).

Cathartes aura. Turkey Vulture.—Less numerous than the above but noted at considerably greater elevations. Harry saw it repeatedly at 8000 to 8500 feet July 23 to 31.

Accipiter spp.—On June 30 Zimmerman saw what he took to be a Sharp-shinned Hawk (*A. striatus*) being pursued by a Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*), 20 miles south of Autlán. On July 27, in the Sierra de Autlán (8300 feet), Harry saw what he believed to be an immature Cooper's Hawk (*A. cooperi*).

Buteo jamaicensis. Red-tailed Hawk.—Noted throughout our stay, at 3000 to 8500 feet, but not common. All seen clearly were adults. Two seen July 15, at 4000 feet, were soaring together (Harry).

Buteo albicaudatus hypospodius. White-tailed Hawk.—The most common hawk of the scrubland and agricultural areas. Often seen "hanging" in air, motionless save for occasional lowering and raising of the legs. Upon sighting prey, "hanging" birds folded their wings and dropped swiftly earthward. On June 23 we saw two birds capturing and eating large flying insects in midair, kitewise. On the evening of July 4 we saw one of two soaring birds suddenly dive at a passing Raven (*Corvus corax*) and pursue it for several hundred yards. Low-flying White-tails were frequently attacked by Olive-backed Kingbirds (*Tyrannus melancholicus*). We took an adult female White-tail in non-breeding condition on July 16, and an immature female on July 25.

Buteo nitidus. Gray Hawk.—Identified with certainty only on July 8 when we saw one flying low over the forest 21 miles south of Autlán.

Parabuteo unicinctus. Harris' Hawk.—Single birds recorded June 29 and July 21 flying over farmland south of Autlán.

Buteogallus anthracinus. Mexican Black Hawk.—Twenty miles south of Autlán, on August 5, we drove to within ten feet of a Mexican Black Hawk perched on a log beside the road. The cere and base of its bill were bright red-orange and its legs bright yellow. When it flew a single white tail band and the white tip showed. Black-looking hawks were seen flying in this tropical forest area several times, July 2 to August 5.

Polyborus cheriway. Caracara.—From July 27 to August 7 we saw several daily. Groups of four or five may have been family parties.

Ortalis vetula. Chachalaca.—Noted occasionally among large trees in the tropical deciduous forest and in wooded arroyos near Autlán.

Dendrortyx macroura. Long-tailed Partridge.—On July 2, in an open grove of oaks ten miles south of Autlán (5000 feet), Harry "squeaked" a covey of several birds to within ten yards

and collected a female. The eyes of this bird were dark brown, the fleshy parts otherwise bright orange red.

Philortyx fasciatus. Banded Quail.—Fairly common in the arid scrub, coveys of 10 to 20 birds being seen almost daily. When running through the brush they often uttered a rapid, high-pitched *pip-pip-pip*. When they burst into the air a muscial *pee-pee-pee-eeeee* accompanied the whir of their wings. The crop of a female taken July 13 was filled with small beetles. Apparently the Banded Quail has not been previously recorded from Jalisco (see Friedmann, Griscom and Moore, 1950. "Distributional Check-List of the Birds of México," pt. 1, p. 75).

Colinus virginianus. Bob-white.—Coveys fed with small doves in the scrubland and plowed fields near Autlán. They were very wary.

Jacana spinosa. Jacana.—On August 7 we observed two birds in a pond (choked with water hyacinth) about 40 miles northeast of Autlán.

Actitis macularia. Spotted Sandpiper.—One record: a bird with spotted under parts seen at a roadside pool 30 miles northeast of Autlán on August 7.

Zenaida asiatica mearnsi. White-winged Dove.—Seen frequently (one or two a day) in the dry scrub throughout our stay. Our only specimen, a female with enlarged ovary taken July 11, measures: wing, 155.5; tail, 111 mm.

Scardafella inca. Inca Dove.—Up to five pairs seen daily in the scrubland. On August 4 we found a nest (with bird incubating two eggs) about ten feet up in a giant cactus. An adult and a juvenile were taken July 27.

Columbigallina passerina pallescens. Ground Dove.—A few observed almost daily in the scrubland. We did not find a nest, but the oviduct of a female taken July 26 held an egg nearly ready for laying.

Leptotila verreauxi. White-fronted Dove.—Recorded only on July 15 when Zimmerman took an immature male northeast of Autlán. The irides of this specimen were pale yellow, the bare circumorbital region dull lavender-pink, the loral area dull blue. The abdomen and under tail coverts are much darker and buffier than those of an immature male specimen of *L. v. angelica* (from Texas) at hand.

Ara militaris. Military Macaw.—Recorded three times: three flying together six miles south of Autlán, June 26; a single bird, July 5; and a flock of 12 flying over the tropical deciduous forest, July 8.

Aratinga canicularis. Orange-fronted Parakeet.—Abundant in the tropical deciduous forest south of Autlán. Individuals, pairs, and flocks of up to 80 were seen repeatedly. They were noisy, particularly at dawn when they came in large numbers to the fig trees near camp. Our two specimens, both much worn (male, wing, 132, tail, 94 mm.; female, wing, 133.5, tail, 97), resemble the race *clarae* in that "the greenish blue of the crown continues anteriorly around the bare space in front of the eye. . ." (Moore, 1937. *Proc. Biol. Soc. Washington*, 50: 101); but their measurements, admittedly not satisfactory because of wear, seem to be closer to those of *eburnirostrum* (*ibid.*, p. 102).

Forpus cyanopygius. Mexican Parrotlet.—We saw flocks of 10 to 20 of these wary tiny parrots in and along the edges of the forest 20 to 22 miles south of Autlán in late June and early July. We usually saw them in the early morning with the flocks of Orange-fronted Parakeets.

Piaya cayana mexicana. Squirrel Cuckoo.—Noted occasionally in the forest 20 miles south of Autlán, July 2 to 8. Seen and heard infrequently in the arid scrub near town where a male was taken June 25. The irides of this bird were bright cherry red. A large grasshopper was in its stomach. The call of this species was a loud, measured *chuck . . . chuck . . . chuck . . .*, as many as 40 or 50 notes repeated in slow succession.

Geococcyx velox melanchima. Lesser Road-runner.—Observed occasionally in the scrubland and along the roads at from 3000 to 4000 feet. A male taken by Zimmerman on June 28 had been feeding on large red ants. The irides of this bird were brown with a dark buff ring around the pupil; the bare skin around the eye was bright blue except for a small area of blood red

posteriorly; the bill was gray above, pale blue-green below, the legs greenish in front, blue behind. Several times we saw Lesser Road-runners pursue and capture small lizards.

Crotophaga sulcirostris. Groove-billed Ani.—One of the most common birds of the farmlands, associating with Red-eyed Cowbirds (*Tangavius aeneus*) among cattle in the fields, sometimes perching and feeding on the animals themselves. Two nests, found in low acacias along the road June 28 and July 12, appeared to be built entirely of sticks. The usual call note was a burro-like *chaw-eek* or *cha-eek-eek*, the last one or two syllables higher than the first. An adult male (testes unenlarged) was taken near Autlán on June 27. A nearly flightless young bird captured July 23 was infested with larvae similar to those discussed under *Megarynchus pitangua*.

Glaucidium minutissimum. Pygmy Owl.—Infrequently recorded in and along the edges of the tropical deciduous forest south of Autlán. Ordinarily we found three or four birds together in the lower branches of the larger trees. Two were seen in a mimosa thicket a mile north of

Pygmy Owl (*Glaucidium minutissimum*). Photographed 19 miles south of Autlán, Jalisco, México, June 30, 1949, by Dale A. Zimmerman.

Autlán (3000 feet), June 25. Our single specimen (male, possibly immature, taken June 30 at 1500 feet) appears to be identical with a Guerrero specimen of *G. m. griscomi* in the Museum of Comparative Zoology except that it is smaller (wing, 82; tail, 51 mm.) and its pileum is unspotted. Both of these variations may be due to immaturity, or it is possible that our specimen represents the race *palmarum*.

Nyctidromus albicollis. Pauraque.—Identified only in forest clearings 20 to 23 miles south of Autlán. The behavior of an adult bird flushed by Zimmerman was interesting: after alighting it raised itself on its legs and bobbed its head up and down several times. When approached closely it flew some 50 feet, flopped to the ground, quickly turned and bobbed its head once or

twice, then flew back and landed almost at the observer's feet. Here it continued its head-bowing for nearly a minute, whereafter it flew out of sight. Perhaps it was trying to divert attention from its young. Thirty minutes earlier Zimmerman had accidentally killed the only two young known to be in the vicinity when he had shot the adult male that apparently was brooding them.

Phaethornis superciliosus. Long-tailed Hermit.—Twice during the morning of June 30 Zimmerman clearly saw a bird of this species at very close range plucking insects from a spider's web above a small forest stream. Friedmann, Griscom and Moore (*op. cit.*, p. 161) do not list this species from Jalisco.

Amazilia beryllina viola. Berylline Hummingbird.—Zimmerman shot a male in oak forest (4000 feet) south of Autlán July 16. Others were seen there several times during July.

Amazilia rutila. Cinnamomeous Hummingbird.—Common at the forest edge 21 miles south of Autlán, being seen there daily.

Cynanthus latirostris. Broad-billed Hummingbird.—Several seen and a male (wing, 49.5; tail, 31.5; culmen, 20 mm.) taken northeast of Autlán, June 25. This bird has the measurements and white under tail coverts of *magicus*, but the merging of the blue of the throat with the green of the belly is even more pronounced than in a topotype (at hand) of *propinquus*.

Heliomaster constanti. Plain-capped Star-throat.—Several seen feeding with the commoner Broad-bills among giant cactus flowers, June 25. Immature male taken that day.

Trogon mexicanus. Mexican Trogon.—Noted by Harry on July 23, 26, and 29 in pine-oak forest between 7500 and 9000 feet on the Sierra de Autlán.

Trogon elegans ambiguus. Coppery-tailed Trogon.—One to six seen daily in the tropical deciduous forest south of Autlán. Breeding female and male taken June 30 and July 5 respectively. Young bird seen July 9.

Trogon citreolus. Citreoline Trogon.—Recorded only on July 6 when Zimmerman collected a singing male (enlarged testes) in the forest 21 miles south of Autlán. The plumage of this specimen is nearly identical with that of an adult female. The head, back, and tail are plain slate gray without a single iridescent feather. The mottled brown alula of the right wing and the plumulaceous character of some of the under tail coverts suggest immaturity. The song of this individual was a low, soft *hoo-koo, hoo-koo, hoo-koo*. The brilliant lemon yellow iris showed clearly in the field.

Momotus m. mexicanus. Russet-crowned Motmot.—Single birds seen infrequently near streams in the forest 15 to 21 miles south of Autlán. Adult female taken July 6 (Zimmerman).

Colaptes cafer. Red-shafted Flicker.—Noted occasionally in pine forests (7500–8000 feet) on the Sierra de Autlán in late July (Harry).

Centurus chrysogenys flavinuchus. Golden-cheeked Woodpecker.—Abundant in the scrubland among giant cacti; less numerous at the edge of the tropical deciduous forest. On June 25 Zimmerman observed what he believed to be a courtship display: a male, perched on a large cactus fruit, bowed elaborately, swaying and spreading his wings, sometimes hanging upside down, before a female. These actions were accompanied by a flicker-like *chicker-chicker-chicker*, etc. The performance lasted about three minutes. Adult (female in coloration) with well-defined brood-patch taken June 24.

Balanosphyra f. formicivora. Acorn Woodpecker.—Seen occasionally in oak and pine forests at about 8000 feet. Harry collected a female, July 25.

Piculus auricularis. Gray-crowned Woodpecker.—Zimmerman collected an adult female in scrub oak forest (4500 feet), July 29.

Dendrocopos scalaris centrophilus. Ladder-backed Woodpecker.—One or two pairs seen daily in the scrubland. A male taken July 27 (wing, 101; tail, 56; culmen, 22.5 mm.) and a female taken July 25 (wing, 94, culmen, 18.5 mm.) have the dark under parts and broad black dorsal bars of *centrophilus*.

Dendrocopos arizonae fraterculus. Arizona Woodpecker.—Harry took a female in mixed pine-oak forest (8000 feet), July 23. The wing (100 mm.) of this bird is shorter than that of the

shortest-winged female *D. a. fraterculus* measured by Ridgway (1914. *U. S. Natl. Mus. Bull.* 50, pt. 6, p. 263).

Xiphorhynchus flavigaster. Ivory-billed Woodcreeper.—Seen sparingly in the tropical deciduous forest during July and early August. Two immature males taken (July 9; August 5). In neither of these is the bill or tail full grown. The August specimen (bill, 24 mm.) appears to be the older. In both specimens the throat feathers are buff, tipped with dusky, and the breast markings are distinct, the buff striping being more sharply defined than that of adults. The plumage has a rich yellowish cast throughout, probably a concomitant of immaturity.

Platypsaris aglaiae albiventris. Rose-throated Becard.—Recorded three times. By following a food-carrying female Zimmerman found a nest in a large, isolated fig tree in a plowed field near Autlán on July 26. The tree held also an occupied nest each of the Vermilion Flycatcher (*Pyrocephalus rubinus*) and Mexican Cacique (*Cassiculus melanicterus*). The ragged, bulky becard nest was about ten inches long and eight inches wide, and was attached to the tip of a long branch 30 feet above the ground. Both adults made regular trips to the nest but only the female was seen with food in her bill. Three days later there was no sign of the becards at or near the nest. Zimmerman took a breeding male near Autlán on July 23.

Tityra semifasciata. Masked Tityra.—Rather common in forest south of Autlán. Conspicuous because of its coloration, loud calls and fearlessness. Usually seen in groups of four or five. Small fruits seemed to be its principal food though the stomach of one specimen contained a few insects. Our two specimens (males, June 30, July 21) are slightly darker, especially above, than male specimens of *personata* at hand, and the black of the outer webs of the lateral rectrices is extensive (wing, 133.5, 130 mm.; tail, 81, 76.5; culmen, 26, 26.5; tarsus, 27, 28); probably they represent the race *griseiceps*.

Pyrocephalus rubinus mexicanus. Vermilion Flycatcher.—The most abundant flycatcher and one of the commonest birds of the arid scrub. Nests with young found June 30 and July 26 were about 20 feet above ground in large trees. That found July 26 was in a fig tree which also held active nests of *Cassiculus melanicterus* and *Platypsaris aglaiae* (see above). Two males and four females taken June 29 to August 2.

Tyrannus melancholicus occidentalis. Olive-backed Kingbird.—Seen regularly in the farming areas and scrubland near Autlán, but not common. Specimens taken: adult male, June 29; two young males, August 5.

Tyrannus crassirostris. Thick-billed Kingbird.—A noisy, conspicuous species recorded six times, June 29–August 4, in the scrubland. It probably bred there for Zimmerman found three young accompanied by adults on July 26. Some of the notes of this bird are similar to those of a Vermilion Flycatcher but louder and longer: *brrr-zee* or *purr-eet*, the last syllable slurring upward. A longer call, a loud, raucous, throaty *cheek, cheek, cheek, purreek*, was also heard. Our two specimens (males, June 29, July 22) appear to be larger, darker-crowned, and paler below than specimens from Nayarit and Sinaloa.

Myiodynastes luteiventris. Sulphur-bellied Flycatcher.—Encountered wherever we went below 4000 feet but more numerous in the heavy woodlands than in the drier scrub. Usually the most conspicuous bird in the forest, its sneeze-like calls being heard throughout the day. Specimens: male, June 27; female, June 30.

Megarynchus pitangua. Boat-billed Flycatcher.—Seen only in the tropical deciduous forest and rare there. One pair, feeding recently fledged young, seen July 8. The female (collected) was infested with seven white larvae from 1.5 to 2 cm. in length. After the bird died, six larvae emerged, two through the skin of the throat, two from each wing at the wrist. Another was found in the throat during the skinning process. The flycatcher was taken within 60 miles of the type locality of *caniceps*, yet its measurements are closer to those of *tardiusculus* (exposed culmen, 31.5; width of culmen, 14.5 mm.).

Pitangus sulphuratus. Derby Flycatcher.—Noted occasionally near the forest edge about 20 miles south of Autlán and, especially in late July, in the scrubland up to 3000 feet. Our single specimen (male, July 21) is in juvenal plumage. Its crown is wholly dark except for one yellow feather.

Myiarchus cinerascens inquietus. Ash-throated Flycatcher.—Single individuals recorded July 4 and 13 in the scrubland. Male (wing, 86; tail, 81.5; culmen, 14 mm.) taken on the former date.

Myiarchus tyrannulus magister. Arizona Crested Flycatcher.—Two males in juvenal plumage taken by Zimmerman near Autlán, July 25.

Myiarchus tuberculifer querulus. Dusky-capped Flycatcher.—Bird in juvenal plumage (wing, 75; tail, 77; culmen, 14.8 mm.) collected along the forest edge 22 miles south of Autlán, July 21.

Contopus p. pertinax. Greater Pewee.—Observed July 16 (adult feeding a young bird) and July 29 in oak forest at 4500 feet. Female (wing, 99; tail, 79; culmen, 15.5 mm.) taken on latter date.

Empidonax difficilis. Western Flycatcher.—Several seen and a male in juvenal plumage taken in pine forest on the Sierra de Autlán at 8100 feet, July 23 (Harry).

Mitrephanes phaeocercus. Tufted Flycatcher.—Seen daily July 25–31 in pine and oak forest on the Sierra de Autlán (Harry). The upper parts of a female taken July 25 at 8000 feet are too dark and the bill is too large for *tenuirostris*.

Stelgidopteryx ruficollis. Rough-winged Swallow.—Single birds seen in Autlán, July 1 and 24. Several flocks (10 to 30 birds) seen feeding over farmland north of town, August 4.

Hirundo rustica. Barn Swallow.—Common in Autlán and around dwellings south of the city. Adults seen feeding young, July 16.

Corvus corax. Raven.—From one to 15 seen daily. Noticeable as they fed in plowed fields at any hour between daybreak and late afternoon. Small groups often observed flying eastward at dusk.

Calocitta formosa collici. Magpie-Jay.—Seen occasionally in rocky arroyos and scrubland. Harry found a short-tailed young bird, evidently just out of the nest, July 12. On July 20, at the same locality, he saw three young all capable of strong flight, but still accompanied by their parents. Adult male (with black crest, auriculars and throat) taken June 24.

Xanthoura yncas speciosa. Green Jay.—Noted along a stream in the oak forest on the Sierra de Autlán, July 28 and 30. A male (wing, 131; tail, 157 mm.) collected by Harry on July 30 has the yellowish-white eyelid feathers (some tipped with blue), yellow forehead, and yellowish bases of the blue hindneck feathers characteristic of this race.

Cissilopha san-blasiana nelsoni. San-Blas Jay.—Common in dense forest south of Autlán (about 1500 feet). Seen in pairs and groups of four or five. Rare in scrub areas at 3000 feet. Birds seen carrying sticks, possibly for nest construction, July 7. The stomach of a female taken June 26 contained insects and a small snail.

Cyanocitta stelleri. Steller's Jay.—Seen daily, July 22–31, in pine forest on the Sierra de Autlán. Female taken July 22 (Harry).

Sitta carolinensis. White-breasted Nuthatch.—Seen frequently in pine-oak forest on the Sierra de Autlán (about 7500 feet), July 23–31. Young male taken July 25 (Harry).

Certhia familiaris jaliscensis. Brown Creeper.—Noted frequently in pine-oak forests on the Sierra de Autlán (7500–8000 feet). Male taken July 27 (Harry).

Campylorhynchus gularis. Spotted Wren.—Found only in clearings and in vegetation beneath scrubby oaks at 4000 feet nine miles south of Autlán. On July 29, on one hillside, Zimmerman encountered six adults and eight long-tailed young birds actively foraging low in the thicket. He collected from a family group the adults and one of three young. The color-pattern of the young bird was quite unlike that of either adult: its underparts were unspotted and its pileum was *black* (brown in adults). It had a black postocular streak and the superciliary line was wider than in the adults. The irides were gray, those of the adults bright rusty orange. This species and *C. jocosus* have been regarded as conspecific by some taxonomists, but the fact that the juvenal plumage of the one differs strikingly from that of the other does not seem to support such a concept (*cf.* van Rossem, A. J., 1938. *Bull. Brit. Ornith. Club*, 59: 11).

Thryothorus sinaloa. Sinaloa Wren.—Noted daily in the scrubland and along the forest edge (1500 to 4000 feet). Its song was a loud *pee, twa, weet-weet, woit-woit-woit-woit*, often end-

ing with a higher pitched *wit!* Two males taken July 9 and 13 are darker and less rufous than six *T. s. sinaloa* specimens at hand (though the brightness of some of these may be due to "foxing"). The dorsal coloration of our birds is closer to that of the geographically-far-removed *cinereus*, while the heavy spotting on the lower belly and abdomen is different from that of any other specimens at hand.

Thryomanes bewicki. Bewick's Wren.—Noted only on July 10 when Zimmerman collected near Aultán one of three young being fed by an adult.

Troglodytes brunneicollis. Brown-throated Wren.—Seen daily July 22–31, in oak, pine, and bunch grass habitats on the Sierra de Autlán (Harry). A young female taken July 27 (8300 feet) is slightly paler below than a female in stub-tailed juvenal plumage from the Mt. Tancítaro district of Michoacán (UMMZ 115,792).

Catherpes m. mexicanus. Canyon Wren.—A few seen or heard daily in Autlán and in nearby arroyos. Adult male (June 29) and young female (August 6) taken.

Toxostoma curvirostre. Curve-billed Thrasher.—Seen occasionally in scrubland in late July. Young birds taken July 22 and 25; adult female (wing, 106; tail, 102.5; culmen, 27.5 mm.) taken July 29. On the basis of measurements the adult seems closer to the nominate race than to *occidentale*.

Mimus polyglottos. Mockingbird.—Seen occasionally in roadside thickets between Autlán and Guadalajara.

Turdus migratorius. Robin.—Adults and young seen July 25–27 in pine and oak forests on the Sierra de Autlán (Harry).

Turdus r. rufo-palliatus. Rufous-backed Robin.—Seen only in the tropical deciduous forest south of Autlán. Its alarm note, a low *chuck*, reminded us of *T. migratorius*. Adults were seen carrying food, July 21. The irides of a freshly killed male (July 21) were rusty brown, the eyelids and bill ochre-orange.

Turdus assimilis renominatus. White-throated Robin.—Found in the same habitat as the above but twice as numerous and usually stayed high in the trees, seldom near the ground. Song, call notes, and behavior very similar to those of *T. migratorius*. A male taken June 30 is more tan and less olive-gray below, and appreciably duller, paler, and less olive above than examples of the nominate race. It is even somewhat duller than specimens of *renominatus* at hand. Female taken July 9. Irides of both sexes were dark rusty, the eyelids lemon yellow, and the bill brownish-black above, yellow-brown below.

Catharus occidentalis fulvescens. Russet Nightingale-Thrush.—Heard at dawn and dusk daily, July 21 to 31, near mountain streams in oak forest on the Sierra de Autlán (Harry). Adults and young taken July 28 and 29. The adults differ puzzlingly *inter se*, the female being brighter than the male throughout the upper parts.

Sialia sialis. Bluebird.—Seen infrequently in scrubland and oak forest (3000 to 4000 feet). Two males (adult and young) taken August 4.

Polioptila plumbea bairdi. Black-capped Gnatcatcher.—Seen occasionally in the scrubland. Our female (July 4) agrees with specimens of *P. plumbea bairdi* at hand, though the tail (50.5 mm.) is longer than Ridgway's average (43.5) for females of that form. A male (July 23) is also close to *bairdi* but the white in the second rectrix is more restricted than in most specimens of that race at hand.

Ptilogonys cinereus. Gray Silky-Flycatcher.—Female (plumage badly worn) taken on the Sierra de Autlán, August 1 (Harry).

Lanius ludovicianus. Loggerhead Shrike.—Fairly common in the scrubland. On July 27 three young birds, capable of feeding themselves, were seen begging from an indifferent adult.

Vireolanius melitophrys goldmani. Chestnut-sided Shrike-Vireo.—The chest-band of a male taken by Harry in pine forest on the Sierra de Autlán (9000 feet) July 25, is rufous, not deep chestnut (as in the nominate race); contrary to Nelson's original description of the type of *goldmani* (1903. *Proc. Biol. Soc. Washington*, 16: 155), however, the gray of the pileum meets abruptly the green of the back. The type of *goldmani* is, of course, a female.

Vireo huttoni mexicanus. Hutton's Vireo.—Females taken July 27 and 31 in pine-oak forest on the Sierra de Autlán (Harry).

Vireo h. hypochryseus. Golden Vireo.—Singing male taken July 5 along the forest edge 21 miles south of Autlán (Zimmerman). The irides of this bird were bright rusty-brown, the bill bluish, tinged with pink below, and the legs gray-blue. Two small yellow birds seen along a stream 19 miles south of Autlán, June 30, were probably of this species.

Vireo olivaceus hypoleucus. Red-eyed Vireo.—Present in the scrub forest near Autlán, but more abundant near edge of tropical deciduous forest farther south. Adult female taken June 24. A nest found July 6 was in a sapling, on a dead branch eight feet above a dry stream bed. An adult was on the nest. Another adult, which had been singing nearby, promptly attacked and pursued a cacique that alighted in a tree some 20 feet from the nest.

Nest and egg of Rufous-capped Warbler (*Basileuterus rufifrons*). Two other eggs were in the grass close by. Photographed 20 miles south of Autlán, Jalisco, México, July 21, 1949, by Dale A. Zimmerman.

Parula pitiayumi pulchra. Pitiayumi Warbler.—Male and female taken nine miles south of Autlán July 15 and 16.

Myioborus m. miniatus. Bright-bellied Redstart.—Several seen and a female in juvenal plumage taken on the Sierra de Perote (5000 feet), July 2 (Harry).

Euthlypis l. lachrymosa. Fan-tailed Warbler.—Male taken July 19 in a forested ravine nine miles south of Autlán (Zimmerman). This bird seems to represent the nominate race, though its wing-length (70.5 mm.) is less than that of four Tamaulipas males (73–75, average, 74) in the Sutton collection.

Ergaticus ruber. Red Warbler.—Seen daily, July 23–29, in oak and pine-oak forests (8000 feet) on the Sierra de Autlán. Male taken July 23 (Harry).

Basileuterus belli bateli. Bell's Warbler.—Seen daily in oak and pine-oak forest, Sierra de Autlán, July 22–31. Specimens taken: female (wing, 62, tail, 60 mm.), July 22; female (?) (wing 62.5, tail 59 mm.), July 30; juvenile (sex?), July 22.

Basileuterus rufifrons dugesi. Rufous-capped Warbler.—Seen frequently on brushy, grass-covered hillsides south of Autlán (4000 feet). Less common along the forest edge at about 1500 feet. A nest containing four well developed young, found in the latter area July 8, was on the bank of a roadside drainage ditch. It was well concealed by long, overhanging grasses and constructed of the same material, being lined with finer grasses and rootlets. Both adults were feeding the young. On July 21, our next visit, this nest contained one *egg* and two others were in the grass a foot or so away, but we did not see the warblers themselves. The song of this species resembles that of a Chipping Sparrow (*Spizella passerina*), and was recorded by us as *ti-ti-ti-ti-ti-ti-ti* and *che-che-che-che-che*. Adults at the nest uttered a soft *tip*.

Passer domesticus. House Sparrow.—Not common at Autlán. An occupied nest found there June 24.

Cassiculus melanicterus. Mexican Cacique.—A conspicuous bird of the tropical deciduous forest. Mornings and evenings we heard its notes there—an odd *ker-yack, ker-yack, ker-yack*, and a somewhat *Agelaius*-like *cheedle-quaaaaa*. Two males taken (July 20; July 26). Its long pendulous nests were on the lower branches of tall, isolated trees along the forest edge. We saw no evidence of colonial nesting. An active nest found July 26 was in a fig tree: in the same tree were two other active nests—one of the Vermilion Flycatcher and one of the Rose-throated Becard. A cacique nest found July 7 probably held eggs, for we saw the adults change places several times that day. Nesting caciques ordinarily were tolerant of other birds, but we saw one male chasing a Golden-cheeked Woodpecker that had alighted in the cacique's nest-tree.

Tangavius a. aeneus. Red-eyed Cowbird.—Small flocks seen in farming areas and scrubland throughout our stay. Specimens taken June 26, July 26, and August 4. Our single adult male measures: wing 114.9, tail 78.5 mm.

Molothrus ater obscurus. Brown-headed Cowbird.—A bird in juvenal plumage collected in the scrubland August 4 was the only Brown-headed Cowbird we encountered. In this specimen the outer rectrices are marked with buffy white in such a way as to give the tail a pattern much like that of a Chestnut-collared Longspur (*Calcarius ornatus*).

Cassidix m. mexicanus. Great-tailed Grackle.—Small numbers seen near Autlán throughout our stay. Immature male taken August 5.

Icterus w. wagleri. Wagler's Oriole.—Pairs seen July 14 and August 2 near water holes in the scrubland. A male taken July 14 approaches *castaneopectus* in size (wing, 112; tail, 115; culmen, 23 mm.).

Icterus pustulatus. Scarlet-headed Oriole.—Common in the scrubland. Seen occasionally along the forest edge at 1500 feet. Adults seen feeding a recently fledged bird, July 7. Three specimens taken from a flock of eight immatures, August 3. Our adult males (June 26, July 10) possess the small lanceolate dorsal markings of *microstictus*, though the size of these markings differs greatly in the two specimens.

Sturnella magna. Meadowlark.—Seen and heard June 23 and August 7 in fields 20 miles northeast of Autlán.

Piranga flava. Hepatic Tanager.—Seen in oak forest (4000 feet) and among pines (8000 feet) in the mountains near Autlán. Adult and sub-adult males taken July 19 and 25; female taken July 19.

Piranga erythrocephala. Red-headed Tanager.—Male taken from a group of four immatures on July 19 (Zimmerman).

Habia rubica rosea. Red Ant-Tanager.—Zimmerman collected the male of a pair found along a stream in a wooded arroyo 19 miles south of Autlán, July 2.

Guiraca caerulea. Blue Grosbeak.—Pairs recorded at Autlán, July 13 and 21.

Passerina versicolor. Varied Bunting.—Singing male (testes enlarged) taken six miles north-

east of Autlán, June 25. On the basis of measurements this bird seems closest to *dickeyae* (wing, 66; tail, 51.5 mm.).

Passerina l. leclancheri. Leclancher's Bunting.—Seen occasionally on brushy hillsides northeast of Autlán. Its song, which was much like that of the Indigo Bunting (*Passerina cyanea*), was often heard during the warmest hours of the day when most species were silent. Males (wing. 66, 66.5 mm.) taken June 24 and August 4. Female (wing, 60 mm.) taken July 10.

Carpodacus mexicanus. House Finch.—Seen daily in Autlán, though not common there. Adults seen feeding young July 12 to 23.

Sporophila t. torqueola. Seedeater.—Immature male (wing 54.5, tail 45.5 mm.) taken two miles south of Autlán, July 26.

Volatinia jacarina. Blue-black Grassquit.—Common in the scrubland. Its song, a thin, buzzy *wee see chew* (last syllable dropping) or *wee see sit* (last syllable rising), was usually given from the top of a low bush or fence wire. Males (testes enlarged) taken July 4 and 23. One of these has black under wing coverts, while the coverts and bases of the remiges of the other bird are largely white. These birds were taken in an area included in the range of *V. j. diluta* by van Rossem (1938. *Bull. Brit. Ornith. Club*, 58: 131).

Spinus p. psaltria. Dark-backed Goldfinch.—Seen frequently among oaks at about 4000 feet. Male taken July 16.

Atlapetes torquatus virenticeps. Green-striped Atlapetes.—Common in oak forests on the Sierra de Autlán (6500–8500 feet). Male taken July 22.

Pipilo ocai. Collared Towhee.—Seen frequently in oak forest on the Sierra de Autlán July 23–29. Less common in pine forest and bunch grass meadows. Female taken July 23 (Harry).

Pipilo fuscus. Brown Towhee.—Seen occasionally in scrubland and oak forest up to 5000 feet. A male (wing, 92.5; tail, 90.5; culmen, 14 mm.) taken August 4 is paler below than specimens of *P. f. fuscus* examined.

Melozone k. kieneri. Rusty-crowned Ground Sparrow.—Noted infrequently in heavily forested arroyos at 2000 feet, scrub forest (3000 feet), and oak forest (5000 feet), but most common in dense undergrowth in arroyos from 3000 to 4000 feet. Harry found a nest containing three pale bluish-white eggs, July 12. It was built of grasses and placed three feet from the ground in a shrubby vine. Male (July 2) and female (July 11) taken.

Aimophila h. humeralis. Black-chested Sparrow.—Locally common in the scrubland, being found in small loose colonies, often in association with the following species. Its song was a rapidly executed, run-together *che-ti-ti che-ti-ti chi-chiti chititi*, etc. The songs of this species and *A. ruficauda* were quite similar: both species gave duet performances. The alarm note of the present species was a metallic, junco-like *pit*. Four adults taken, July 4–August 4.

Aimophila ruficauda acuminata. Russet-tailed Sparrow.—The most noticeable species in the scrubland, inhabiting fence rows and acacia thickets. What we presumed to be mated pairs often sang in duet. When performing one bird would fly into a low bush, chatter a bit, and then, after a short buzzy fiight low over the ground, join another bird. Soon both birds would perch side by side, or one just above the other, and begin singing together a rapid, vigorous *see-chee-see-seeche, see-chee-see-seeche*, over and over. This would continue for half a minute to two minutes before the birds would fly off into the brush. Zimmerman found two nests, each with three white eggs, July 20 and 27. About five feet above ground in low acacias, they were loosely built of thin twigs and grasses, lined with horse hair. Four adults taken June 24–August 5.

Aimophila ruficeps. Rufous-crowned Sparrow.—Male taken July 16 nine miles south of Autlán. This specimen bears little resemblance to some examples of *fusca* at hand, being more striped and not so reddish above. A topotype of this race (U. S. Natl. Mus. 135910) is redder in general tone above than the Autlán bird, though it is not very different in any other respect. The auriculars of the topotype are buffy; those of our specimen are gray.

Junco phaeonotus. Red-backed Junco.—Seen daily July 23–31 in bunch grass meadows

(8000–9000 feet) on the Sierra de Autlán. A female taken July 23 seems closest to *australis* on the basis of bill measurements. The outer tail feathers, however, have much more white than examples of that race at hand. In this respect the specimen is similar to *J. p. palliatus*.

UNIVERSITY OF MICHIGAN DEPARTMENT OF BOTANY, ANN ARBOR

NEW LIFE MEMBER

H. Lewis Batts, Jr. was born at Macon, Georgia, on May 24, 1922. He received a Bachelor's degree from Kalamazoo College in 1943, and a Master's from the University of Michigan in 1947. During World War II, he served for three years in the U. S. Army Medical Department. He now is teaching ornithology, ecology, and general biology at Kalamazoo College, and is completing an ecological study of breeding birds for his doctoral thesis. He is an assistant editor of *The Jack-Pine Warbler*, Treasurer of the Michigan Bird Banders' Association, a Life Member and member of the Board of Directors of the Michigan Audubon Society, a Vice-President of the Audubon Society of Kalamazoo, a Life Associate of the A.O.U., and a member of the Cooper Ornithological Club, Georgia Ornithological Society, National Audubon Society, Ecological Society of America, American Society of Mammalogists, American Association for the Advancement of Science, and the Photographic Society of America. His special interests are bird-banding, ecology, and photography. His published papers deal with Georgia field trips, and Goldfinch observations in Michigan.

NOTES ON THE ORNITHOLOGY OF SOUTHEASTERN SAN LUIS POTOSI

BY GEORGE H. LOWERY, JR., AND ROBERT J. NEWMAN

On the basis of current estimates, about one-half of the species comprising the avifauna of México occur also in the state of San Luis Potosí, in the east-central part of the republic. As recently as 12 years ago, however, it would have been difficult to find definite published evidence for the presence there of even 200 kinds of birds. Several factors contributed to this circumstance.

In the earlier days of Mexican ornithology, the middle latitudes of the country were less accessible to visiting naturalists than the northern and southern parts and offered less promise. The few ornithologists who did reach San Luis Potosí were collectors primarily interested in acquiring the novel and the exotic. They must have met with, but passed by, scores of common species obtainable with less effort in the United States. In general, these men left no record of their achievements other than the data on their specimens, and this information has but gradually filtered into the literature through taxonomic reviews and works of a broad distributional nature. Furthermore, the celebrated team of E. W. Nelson and E. A. Goldman were the only early collectors to push down over the rough mule trails into the southeastern corner of the state, where the Sierra Madre Oriental rises abruptly to an altitude of 9000 feet, where the rain forest of San Luis Potosí attains its highest development, and where, in consequence of these combined influences, the most colorful and most varied elements of the birdlife are concentrated. Their brief stay at Xilitla, rendered rather unfruitful by difficulties of terrain and by bad weather, failed to disclose the real potentialities of the surrounding area.

With the official completion of the Pan-American Highway through southeastern San Luis Potosí in 1936, that corner of the state was rapidly to prove itself the richest source of new distributional data in all east-central México. It early attracted the attention of L. Irby Davis, who used it as an area for studies in the field identification of tropical birds. His work was all of an observational nature and has remained for the most part unpublished, so that the full extent of his numerous early accomplishments cannot be gauged. The excellent report on the birds of Tamazunchale and its environs by Sutton and Burleigh (1940b) was the first published locality list from the region. Fifty-nine of the 141 species included had never before been reported from the state, and the proportion would have been larger, had not a slightly earlier publication by the same authors (1940a), on the birds of Valles, listed for the first time species also seen at Tamazunchale. Our own activities in San Luis Potosí began in 1941. They initiated a decade of study which during its latter half has been devoted to a systematic survey of the vertebrate fauna of the state sponsored by the Louisiana State University Museum of Zoology. Our work

in the southeastern corner of the state alone has revealed the presence of well over 80 additional species of birds for which at the time there were no San Luis Potosí records in the literature. State records for many of these birds have subsequently appeared in a breeding bird census (Davis and Johnston, 1947), in Audubon Bird Counts (Newman and party, 1947; Davis and party, 1951), in the first part of the "Distributional Check-List of the Birds of México" (Friedmann, *et al.*, 1950), and in short papers of a taxonomic or distributional character (Lowery and Newman, 1949; Sutton, *et al.*, 1950; Pitelka, 1951).

Meanwhile the list for the whole state, as represented in our files, has climbed to a total of no less than 490 species. A book-length report would be required to set down all that is known, but yet unpublished, about the distribution of these birds on a statewide basis. Pending the preparation of such a report it is possible, however, to compress a relatively large amount of information into a small compass by confining attention to the extreme southeastern portion of the state, arbitrarily defined for this purpose as the area lying south of latitude 21° 28′.

Among the references cited, two relate directly and exclusively to the area herein defined (Sutton and Burleigh, 1940; Davis and party, 1951). Sixty-one of the birds in the Sutton and Burleigh paper and, of course, all of the records in the 1951 Christmas bird count, were included on the basis of sight identifications. Our collection contains corroboration of the state occurrence of all but three of these species. The exceptions are the Mississippi Kite, in the Tamazunchale report, and the Tennessee Warbler and Grace's Warbler, in the bird count. The latter was made on December 28, 1950, by Davis and 19 collaborators within a circle 15 miles in diameter, centered one mile north of Xilitla. Their spectacular list of 230 species far exceeds the results for any previous effort of this sort and shows that the Xilitla area encompasses a variety of birdlife unsurpassed by any known district of its size on the North American continent. While it is true that 40 of the birds included have never been noted by us in the same locality in winter, this result may be attributed in large measure to a "norther" of unprecedented severity that shifted many birds of western range transiently to the east. Most of the 31 species formally attributed to San Luis Potosí for the first time in the Xilitla bird count have an unchallengeable right, as indicated above, to a place on the state list, at least on the basis of occurrence in other localities or at other seasons.

There remain another 32 species that are found in southeastern San Luis Potosí but whose presence in the state is still generally unknown. The majority of these birds were recorded not far from Xilitla, within the boundaries of the bird count territory defined by Davis—an area of such tremendous interest that we and our associates have devoted 1650 party hours to its exploration. These birds are listed in the account that follows, together with an indication of their status in southeastern San Luis Potosí, their observed altitudinal range, the essential details concerning the first record and first specimen from

the area, and brief taxonomic comments where pertinent. All sight identifications and specimens cited in detail but not otherwise credited represent the work of Newman.

Cairina moschata. Muscovy Duck.

The wild ancestor of our domestic duck of the same name, apparently resident in small numbers on the Río Huichihuayán, at an elevation of 400 feet or less. It was first observed at the dugout crossing near the village of Huichihuayán, on June 20, 1942, when a pair was noted. A female was later shot by Charles Shaw 1 mile west of the village, on August 29, 1947.

Micrastur ruficollis. Small Forest Hawk.

Our three records of this trim little hawk of the dense rain forest are all of birds collected in the vicinity of Xilitla, at elevations of from 600 to 4000 feet. An immature male was taken by Shaw on September 9, 1946, in a ravine about 2.5 miles by road from the Pan-American Highway, along the road to Xilitla; an adult male and an adult female were taken subsequently. Since each specimen is in a different plumage, it is not possible to evaluate fully the color-characters of this extreme northern population of the species. The wing and tail measurements of each, however, fall within the limits of variation for the Mexican race, *M. r. guerilla*, as given by Friedmann (1950: 575).

Falco albigularis. White-throated Falcon.

A small tropical falcon, noted several times in the area, within an altitudinal range of 400 to 2800 feet. Our initial observation of this species in San Luis Potosí was that of two individuals seen in the vicinity of the Río Huichihuayán on December 20, 1946. A female shot 2 miles northwest of Xilitla on January 29, 1947, is definitely assignable to *F. a. albigularis*, though several San Luis Potosí specimens, like material from farther north, show some of the paleness characteristic of the western race, *F. a. petrophilus*—a resemblance we believe to be of independent origin.

Dendrortyx barbatus. Bearded Wood-Partridge.

Though unreported anywhere in the present century, the Bearded Wood-Partridge is a not uncommon resident of the mountain forests back of Xilitla, from 4000 feet to probably 7000 feet. Its presence there was not definitely established until June 12, 1947, when a female and three downy young were captured in the cloud forest on Cerro San Antonio. Adults are so difficult to secure that our present series of nine of these partridges, comprising every major developmental stage, includes only one fully mature bird. While we are not, therefore, yet certain that recognizable geographic variation occurs in this species, the possibility of such variation is rather definitely indicated.

Heliornis fulica. Sun-Grebe.

The Finfoot or Sun-Grebe, otherwise unknown north of Boca del Río near the city of Veracruz (*cf.* Warner and Mengel, p. 290 of this issue) was found only on the Río Huichihuayán between the village of Huichihuayán and the ferry crossing on the road to Xilitla, a stretch of river where on occasion several have been seen in a day. It was first recorded on December 14, 1941, and first collected (by David Cutler) on August 29, 1946.

Oreopeleia albifacies. White-faced Quail-Dove.

This heavy-bodied, slate-headed dove occurs, and probably is resident, in cloud forest above Xilitla, at elevations of 4000 to 5000 feet. It was discovered by Shaw on the mountain adjoining the village of Ahuacatlán on September 7, 1946, when he shot one of two birds seen.

damaging it so badly it could not be preserved. Our subsequent series of three specimens, all from Cerro San Antonio, differs in numerous details of coloration from examples of *O. a. albifacies* from central Veracruz, the northernmost district from which the species was previously known. Since, however, only one of our birds is fully adult, we feel that we do not yet have sufficient material to consider naming a new race.

Otus guatemalae. Middle American Screech Owl.

Owls of this species were presumably heard several times at elevations of 5200 to 6800 feet in the mountains of the Cerro Conejo group, but were seen only twice. The first of our two specimens was shot in broad daylight in the forest bordering the Llano de la Cruz on May 9, 1947. The somewhat greater grayness of our material compared with topotypes of *O. g. cassini* from central Veracruz may be simply a matter of individual variation, since too few specimens are available to demonstrate the full probable range of grayness among topotypical birds.

Ciccaba nigrolineata. Black and White Owl.

Although this extremely rare owl was taken on three occasions, in three widely separated months, all three specimens came from a single vine-covered tree in a ravine along the road to Xilitla, the same ravine that also produced the cited example of *Micrastur ruficollis*. This remarkable sequence of records began on September 9, 1946, when Shaw shot a female. According to Friedmann, *et al.* (*op. cit.*, p. 147), the species has hitherto been known in México from only eleven specimens, from Veracruz, Oaxaca, and Chiapas.

Xiphocolaptes promeropirhynchus. Giant Woodhewer.

A flicker-sized woodhewer, which is fairly common in the high forests of Cerro Conejo and the associated peaks, above 6200 feet. It was not certainly identified until May 14, 1947, when a pair was obtained at 7300 feet near Cerro La Luz. Our six specimens, three of which were taken in 1947 and three in 1951, demonstrate the tremendous amount of "foxing," or brightening of the browns, that can occur in the short span of four years. Our early material from San Luis Potosí was impressively darker and duller than the much older skins available from the range of the geographically nearest race, *X. p. sclateri*, in Veracruz and Oaxaca; but it is rapidly becoming indistinguishable from examples of that race.

Xiphorhynchus triangularis. Spotted Woodhewer.

An inconspicuous inhabitant of wooded slopes from 4200 to 6800 feet encountered only in the Xilitla area. A female was shot near the Llano de Garzas on May 24, 1947, and but two other specimens were taken thereafter. All Mexican examples of this species are currently assigned to *X. t. erythropygius*. Our birds differ from the bulk of the material currently representing *erythropygius* in museums; but the differences, being of much the same order as those discernible in the preceding species, are probably the result of postmortem change.

Automolus rubiginosus. Ruddy Automolus.

Our one record for this rare furnariid is that of a male collected at 4000 feet among the tree-ferns on Cerro San Antonio, on June 7, 1948. This specimen cannot be exactly matched among available examples of *A. r. rubiginosus*, which has heretofore been believed to be confined to the neighboring state of Veracruz. Its darker coloration may, however, be explainable on the same basis as that of the woodhewers, while the greater thickness of its bill may not be significant in view of the considerable variation in this character already demonstrable in the nominate race.

Erator inquisitor. Black-capped Tityra.

An uncommon species of the lower tropics, not recorded above 400 feet and most frequently

observed in the low country east of the Pan-American Highway. An immature male (Texas A. and M. College Collection) was taken at the village of Axtla on June 26, 1942, by C. W. Reid and we have encountered the species on five occasions since. Like all Mexican examples of the species, San Luis Potosí birds are assignable to the race *E. i. fraseri*.

Myiarchus crinitus. Crested Flycatcher.

This well-known bird of the eastern United States is doubtless commoner in migration than the three state records indicate, since the presence of five species of *Myiarchus* in San Luis Potosí tends to discourage sight identification. The single specimen from the southeastern corner of the state, a supposed female from El Sol, dated August 22, 1946, has the small bill that is the chief distinguishing feature of *M. c. boreus*.

Empidonax flaviventris. Yellow-bellied Flycatcher.

A common spring and fall migrant and winter resident, found from 400 to 4300 feet. The extreme dates for the state are August 23 (a female taken in 1946 at El Sol) to May 22.

Empidonax hammondi. Hammond's Flycatcher.

One of the commonest winter Empidonaces in the Xilitla area, from 2200 to at least 4500 feet. Dates on specimens extend from January 18 (1947 at the village of Xilitla) to March 10.

Empidonax albigularis. White-throated Flycatcher.

A not uncommon inhabitant of weedy fields around the 4000-foot level immediately above Xilitla, where it presumably breeds. Seasonal limits are uncertain. It was unrecorded until June 17, 1947, when a female was obtained at Rancho Miramar Chico. We have identified our series as *E. a. axillaris*, a race that occurs also in the state of Veracruz.

Pipromorpha oleaginea. Ochre-bellied Flycatcher.

The nine state records of this little flycatcher are all from the humid tropics within six miles of Xilitla, between 600 and 2900 feet. They extend from September 9, 1946, when Shaw secured an immature male in a wooded ravine along the road to Xilitla, 2.5 speedometer miles from the Pan-American Highway, to April 30 (1947). Our two adult males are shorter-winged (63.6, 65.2 mm.) than any of the other 12 males from México and Guatemala that we have examined (65.5–72.9 mm.). The birds from the Tuxtla Mountains of Veracruz in that series are, however, larger than other Mexican material to about the same degree that San Luis Potosí birds are smaller. Nomenclatural recognition of the interesting size trends indicated would therefore require describing not just one but two additional races. Even if more adequate material should bear out these minor trends, we would recommend that all Mexican *Pipromorpha* continue to be called *P. o. assimilis* as at present.

Iridoprocne albilinea. Mangrove Swallow.

A predominantly coastal swallow that ranges inland along the larger rivers, reaching Tamazunchale in small numbers. Although we observed and collected the species farther north in the state much earlier, it escaped our detection within the area of this report until May 17, 1948, when a single bird was seen flying over the Río Amajaqui near its junction with the Río Moctezuma. All Mexican and Central American populations of this species belong to one subspecies, *I. a. albilinea*.

Cyanocitta stelleri. Steller's Jay

A common resident of the higher mountain forests of the Cerro Conejo district, recorded from 6000 to 7200 feet. A female taken on February 25, 1947, near the Llano de la Cruz was the first of our present series of 14 specimens from the area. With the exception of one apparently mutant individual, these are all typical blue-crested *C. s. coronata*, exhibiting no constant differences, either in size or coloration, even from examples of the species from Guerrero.

Henicorhina leucophrys. Gray-breasted Wood Wren.

This tiny but brilliant vocalist is an abundant resident of the upper wooded slopes above Xilitla (recorded altitudinal range: 2000 to 7000 feet). Seemingly it replaces *H. leucosticta* at about the level of the village, where Cutler took a female on September 2, 1946. We have referred our series of 22 specimens to *H. leucophrys mexicana*, though they are somewhat darker in over-all coloration than older material from the range of that race.

Hylocichla mustelina. Wood Thrush.

A rare winter resident and migrant. Our only record for the area is that of a single male secured on December 22, 1946, 6 miles by speedometer east of Xilitla on the Xilitla Road.

Catharus occidentalis. Russet Nightingale-Thrush.

This Veery-like thrush of the deep forest shade is common the year around at elevations above 5000 feet. It was added to the known avifauna of the state on February 25, 1947, when a male was taken near the Llano de la Cruz, at 5800 feet. Two types, distinguished by subtle, but numerous, correlated characters, occur and may represent age classes. These introduce such complications that the whole problem of geographic variation in the species should be reinvestigated on a broad basis. Pending such a reappraisal, we tentatively have placed our Conejo series with *C. o. occidentalis*.

Vireolanius melitophrys. Honey-browed or Chestnut-sided Shrike-Vireo.

An uncommon inhabitant of the wooded mountain district back of Xilitla. Our four records range from 4000 to 6700 feet. One was seen on December 21, 1946, on Cerro San Antonio, but none was collected until May 8, 1947, when a female was taken at 5800 feet, near Puerto del Oso. Pending further study of specimens from Guerrero, all the Mexican material from north of Chiapas may be treated under one name, *V. m. melitophrys*, since the type of *V. m. goldmani* proves to be nothing but an immature example of the nominate race.

Hylophilus decurtatus. Gray-headed Hylophilus.

This rare little vireo, which superficially resembles the Tennessee Warbler (*Vermivora peregrina*), is known in San Luis Potosí only from a mountain along the Pan-American Highway 3.6 speedometer miles south of Tamazunchale, where a pair were taken by Newman and Leonardo Guerrero on May 22, 1948. These specimens have never been actually compared with a representative series of *H. d. decurtatus* from elsewhere in México; but, since the species ranges from Veracruz to Panamá in a more or less continuous habitat without any named geographic variation, it would be surprising if they did not closely agree with that form.

Vermivora chrysoptera. Golden-winged Warbler.

A rare transient in México. The one record for San Luis Potosí is that of a male taken by Shaw on April 19, 1947, one mile south of Xilitla.

Vermivora pinus. Blue-winged Warbler.

Similar in status to the preceding species. There is a single state record, that of a male shot by Lowery on April 3, 1950, 7 miles east of Tamazunchale.

Dendroica fusca. Blackburnian Warbler.

A rather uncommon spring transient, unrecorded in fall. A male was secured one mile west by north of Xilitla at 2400 feet on April 19, 1947, and there is one subsequent record for the same general locality.

Wilsonia canadensis. Canada Warbler.

A spring and fall migrant, more frequently observed than any of the preceding warblers.

It was first noted on September 3, 1946, when a female was collected 1.5 miles north-northwest of Xilitla by Shaw, and three other individuals were observed by the field party.

Myioborus miniatus. Slate-backed or Bright-bellied Redstart.

A fairly common resident of the high elevations back of Xilitla; altitudinal limits, 5800 to 7200 feet. The discovery of the species in eastern San Luis Potosí on May 13, 1947, when a female was obtained at Puerto del Oso, was long preceded by the unpublished records of W. W. Brown at Alvarez in the western part of the state (specimens in American Museum of Natural History). Our small series from eastern and from western San Luis Potosí definitely differ from each other in the coloration of the under parts. It is difficult, however, to imagine a pattern of true geographic variation that would account for this situation, since populations from central Veracruz to faraway Sonora are currently regarded as one subspecies, *M. m. miniatus*.

Icterus wagleri. Wagler's Oriole.

An oriole of the arid plateau, probably merely a stray on the eastern side of the Sierra Madre Oriental. Our one record from eastern San Luis Potosí is that of a male taken on April 19, 1947, at Xilitla. This specimen conforms fairly well with samples of *I. w. wagleri*, but the material from the state as a whole does not. The matter requires further study on a broad geographical basis.

Thraupis episcopus. Blue-gray Tanager.

Not uncommon at low humid elevations throughout the area, from 400 to 2200 feet. It was first seen on June 21, 1942, in a tree-dotted pasture on the outskirts of Tamazunchale and was first taken on September 14, 1946, along the Río Axtla, three kilometers west of the village of Axtla by W. W. Dalquest (skeletal specimen of a female in the collection of the University of Kansas Museum of Natural History). This species extends all the way from San Luis Potosí to Panamá without significant variation, under the name *T. e. diaconus*.

Spizella breweri. Brewer's Sparrow.

Recorded but once in southeastern San Luis Potosí—on April 17, 1948, when a female was secured on the Llano de Conejo, at 7000 feet. It has been referred to *S. b. breweri*.

Place names mentioned in this paper may be identified as follows: **Ahuacatlán,** village south and west of Xilitla, at latitude 21° 19′ N., longitude 99° 03′ W.; **Alvarez,** abandoned rail point in western San Luis Potosí, at 22° 02′, 100° 37′; **Axtla,** village just east of the Pan-American Highway, at 21° 27′, 98° 52′; **Cerro Conejo,** 9000-foot mountain northwest by west of Xilitla, with summit at 21° 27′, 99° 06′; **Cerro La Luz,** unmapped peak about 4 miles from Cerro Conejo, along the crestline of the same mountain mass; **Cerro San Antonio,** unmapped mountain 5000 feet high just west and southwest of Xilitla; **El Sol,** locality on the Pan-American Highway, 1 mile north of Tamazunchale; **Huichihuayán,** village on Pan-American Highway, 25 miles by road north of Tamazunchale, at 21° 28′, 98° 57′; **Llano de Conejo,** unmapped meadow on shoulder of Cerro Conejo at an approximate elevation of 7000 feet; **Llano de la Cruz,** unmapped meadow on shoulder of Cerro Conejo at an approximate elevation of 6000 feet; **Llano de Garzas,** another unmapped mountain meadow in the Cerro Conejo group; **Puerto del Oso,** unmapped pass on the trail between Xilitla and Cerro Conejo, at about 6000 feet; **Rancho Miramar Chico,** unmapped rancho on trail from Xilitla to Cerro Conejo, at elevation of 4000 to 4500 feet; **Río Amajaqui,** an affluent of the Moctezuma River, joining it at Tamazunchale; **Río Huichihuayán,** a branch of the Axtla River, flowing in a course roughly parallel to the Pan-American Highway, south of the village of Huichihuayán; **Tamazunchale,** town on Pan-American Highway

in extreme southeastern San Luis Potosí, 21° 16′, 98° 48′; **Valles,** town on Pan-American Highway, at 21° 58′, 99° 02′; **Xilitla,** village at 21° 23′, 99° 01′ in mountains west of the Pan-American Highway, connected with that highway by an all-weather dirt road.

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THE MOLTS OF THE RUFOUS-WINGED SPARROW

BY ALLAN R. PHILLIPS

THE Rufous-winged Sparrow (*Aimophila carpalis*) is known only to a fortunate few. Its range is limited to a strip of country south from Pinal County, southern Arizona, to northern Sinaloa, México. In our country, the land-speculator, the military, and especially the stockman wage unending warfare on the few places where it still survives. Given a patch of grass and thorn-bushes, it can take good care of itself; but against short-sighted human greed and bulldozers it has no defense. One of the last species of United States birds to be discovered thus bids fair to be one of the first exterminated.

To the casual observer, the loss might seem of no consequence. Modest and retiring, the bird is no popular favorite. Its song is a plain, metallic trill. Other birds build more striking nests and have more engaging habits. Trim, slender and appealing perhaps, but by no means brightly colored: only a press agent could call it beautiful.

Why then, you ask, the "fortunate few?" Because our little subject is unique in some ways. The various other obscure sparrows of the Southwest nest in the spring, and in August and September have the usual complete postnuptial molt. Most of them have also, in March and early April, a partial prenuptial molt, this often being restricted to the chin or to the head and neck. But *Aimophila carpalis* does not nest in the spring. Though sexually active in spring and early summer, it delays its actual nesting until the summer rains. While waiting for these rains it has an almost complete prenuptial molt.

The molts of the Rufous-winged Sparrow have been known for some years; but little has been written about them, and even that little is not altogether correct. Van Rossem (1945: 275) mentioned casually that birds taken "in southern Sonora between May 6 and June 22, 1937 . . . all were in various stages of the complete prenuptial body and tail moult." Moore (1946: 118) discussed the molt at somewhat greater length. Referring presumably to birds taken in the Tropical Zone of México, he stated that "some individuals of *Aimophila carpalis* present feathers in process of molt in every month of the year . . . ." Periods specifically mentioned included January, late February, July, August, late September, and October. A male with a new secondary in one wing on September 18 had fully developed testes. Moore stated that "new secondaries almost invariably develop before the new primaries" (p. 122).

The Rufous-winged Sparrow becomes badly worn on the exposed parts of its feathers, as is usual among grass- and cactus-haunting birds. In the closed wing, the tertials cover and protect the secondaries, while most of the primaries project at their tips. By July and August the primaries in the closed wing look frayed and faded, while the secondaries usually are still in good condition. This, plus the replacement of feathers accidentally lost, may lead the student to believe that a bird is molting when actually no molt is under way.

My studies have extended intermittently over 11 years. They have been greatly aided by the cooperation and suggestions of Lyndon L. Hargrave, Joe T. Marshall, Jr., Gale Monson, Milton B. Trautman, the late Charles T. Vorhies, and the authorities of the American Museum of Natural History, Cornell University, the Fish and Wildlife Service, the United States National Museum, and the University of Arizona. My findings agree in the main with van

Rossem's; they agree with Moore's in revealing that molt and sexual activity are not mutually exclusive, but disagree—in so far as Arizona and northern Sonora birds are concerned—in certain particulars.

Postnuptial Molt

The postnuptial molt of the Rufous-winged Sparrow occurs rather late in the fall. An equally late molt occurs in such related forms as the Blue Grosbeak (*Guiraca caerulea*), Brown Towhee (*Pipilo fuscus*), Rufous-crowned Sparrow (*Aimophila ruficeps*), Cassin's Sparrow (*A. cassini*), and Black-throated Sparrow (*Amphispiza bilineata*), however; so *carpalis* is not unique in this regard. It is the tail molt that is odd, departing as it does from the orthodox pattern.

The postnuptial molt begins with the tertials, tail, coverts (both upper and under) of wing and tail, and in some cases the inner primaries. Soon it spreads to the head and sometimes the back. Of two adults taken in Arizona, September 11, the female shows no regular molt as yet, while the male has begun the molt of wing coverts, upper tail coverts, tertials, and inner primaries. On the other hand, three adults taken there as late as October 9 are not very far along in the molt. One, a female in the American Museum of Natural History, retains the longer wing and tail feathers of the old nuptial plumage, except for the tertials. The other pair (especially the male), though only *beginning* to renew the tertials, have new inner primaries that are already well grown. Molt, then, seems to begin in early or mid-September in males and perhaps two or three weeks later in females. None of the few specimens showing the tail in molt reveals any regular order of molting the feathers. In central Sonora and south, the molt may be even later, at least in some years (Pitelka, 1951).

An adult male, taken in Arizona on September 30 and examined in the flesh, had the tertials and inner five primaries nearly or quite full-grown. The outermost secondary also seemed full-grown, but the next was in a still unbroken sheath. Primary 7 was likewise in an unbroken sheath; 6 was about half grown; and old 8 and 9 had yet to be shed. Molt had begun in the inner secondaries, the innermost being nearly full-grown, but the rest were old feathers. Clearly, this male retained the old secondaries, as a group, and the outermost primaries the longest; and this appears to be the normal pattern. Other old feathers retained were the alula, two outer primary coverts, and the longer *under* primary coverts. The rest of the wing coverts had been renewed. The body was still in heavy molt, advanced especially on the tail, longer tail coverts, head and throat. The shortest obvious tail-feather was the outermost on the right side, but the adjacent two were full-grown, the succeeding one nearly full-grown, and the central four subequal, falling (in the closed tail) 25 to 29 millimeters short of the longest feather (third from right), which already showed a trace of wear. The fourth rectrix from the left was so short as to be barely out of its sheath; only by parting the feathers could it be found. The outer three feathers on the left formed a gently graded series falling 20, 26, and 31 millimeters, respectively, short of the longest rectrix. The shortest (outermost) of the three was almost as short as the right outermost.

The postjuvenal molt resembles the postnuptial, but is incomplete. Of the major flight-feathers, only the tertials are ordinarily molted; but in one Arizona female (U. S. National Museum 79616, September 11, 1874) the inner primaries and two outer pairs of rectrices are in molt. At this season, some birds have nearly finished the postjuvenal molt, while others are not yet full-grown. Most young October specimens from Arizona have some juvenal tail coverts (and often neck, flank, belly, and scapular feathers). Of two November birds, one (Granados, Sonora, November 12) still has a few juvenal upper tail coverts, while the other (Arizona, November 29) has apparently finished the postjuvenal molt.

Prenuptial Molt

I can detect no evidence of molt in series from Arizona and northern Sonora taken from December through April, nor in December and January birds from Álamos, Sonora, nor in

a March male from Sinaloa. Some late April birds look suspiciously unworn, as if recently molted, on the lower back and rump; but this I attribute to the protection afforded these feathers by the overlying wings. An adult male from near Estero de Tasiota, northwest of Guaymas, Sonora, May 3, and a female from nearby Ortiz, May 12, still have not begun the prenuptial molt, but it is evident in a male (probably young) from east of Ures, Sonora, May 5. In this bird the sides of the crown, the postocular portion of the pale superciliary stripe, and the outer tertials are in molt.

Van Rossem, as quoted above, recorded molt in southern Sonora birds from May 6 to June 22. An Arizona specimen taken May 7 is starting the molt of the outer tertials. A female from near Tucson, May 19, is molting over at least the dorsal surface, and has several subequal new rectrices as if it had lost the central part of its tail accidentally. Except in the tail, the molt is farther advanced in two males taken at the same time and place; each has the central pair of rectrices 21.5 millimeters long, while the outer five pairs are old; among the remiges, only the tertials are in molt. Such new feathers as I have seen seem to indicate that, in the spring molt, the tertials are the only remiges regularly replaced. Other fresh feathers at this season may be replacements for accidental losses.

All Arizona specimens taken from May 19 to June 10 are in heavy molt. Of two males taken June 1, one has the entire tail old; the other has the outer four pairs old, the central pair missing or shot out, and the next pair coming in very unevenly (one about two thirds grown, the other just emerging from its sheath). The latter male is well along in its body molt and is molting its tertials and their coverts, greater secondary coverts, and feathers along the radius and tibia.

The general sequence of the spring molt seems to be the same as that of the fall, but it involves the wings and tail less. The old secondaries, primaries, and primary coverts are retained; the other wing coverts seem to be molted rather irregularly, most but not all evidently being renewed. In some young birds, apparently, the alula feathers molt. The tail is partly retained, only the central pair (and occasionally one or two adjacent rectrices) being shed.

One of three specimens taken near Tucson on June 30 still has a central tail-feather only about three-quarters grown. This date marks about the end of the prenuptial molt. No molt was evident on the other two birds except that the female lost one pinfeather from the downy area near the flanks in skinning. About three ova were greatly enlarged (at least one was in the oviduct), and a nest which I found nearby held one egg. July and August specimens examined, few in number, show no regular molt. This is the nesting season in Arizona, the time of summer rains.

In a general way, then, the Rufous-winged Sparrow undergoes a regular sequence of alternate molting and nesting, or both, from early May continuously until November. Molting and sexual activity can and do overlap. During May and June the males sing freely and, in all probability, are mated and defending territory. These points need detailed study; but there is no doubt about the swollen testes, which measure from 4 by 3½ up to 6 by 4 millimeters during the spring molt. This is about maximum size for birds weighing 14.4 to 17.3 grams.

In the well-watered localities that once existed around Tucson, nesting probably began in late May. Stephens (Brewster, 1882: 196) found a nest and three eggs on May 25, 1881. Bendire (1882) found eggs about June 14, 1872, and believed the birds had commenced to breed "about a month earlier." Birds, grass, and water are nearly all gone from these streambottoms today; but it seems unlikely that there can have been much difference in the season of molt among different populations within the Tucson valley. Thus, laying and even incubation apparently occurred during molt.

Summary

The Rufous-winged Sparrow has a late postnuptial molt differing from that of most birds in lacking a regular sequence of molting the tail-feathers. Again in May and June it undergoes

a nearly complete prenuptial molt. Parts of the wing and tail are not involved in this molt; in the tail it is limited usually to the middle pair of rectrices. It is later than the spring molts of other fringillids, and overlaps periods of sexual activity.

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Museum of Northern Arizona, Flagstaff

PHOTOGRAPHIC RECORDS OF CAPTURED BIRDS

BY B. M. SHAUB[1]

DETAILED photographs of living birds held captive at banding stations have appeared from time to time especially in ornithological journals published abroad. Photographs of this sort should, it seems to me, be preserved for record far more often than they are. Killing a bird and preserving its skin or skeleton is one way of establishing a record, of course; but if the banded bird can be studied, weighed, photographed, released, recaptured, photographed again, etc., the possibilities are well nigh limitless. All sorts of plumage and growth studies might be carried on—or at least aided and abetted—in this way, not to mention the distributional data which might in time accumulate as it became apparent that certain subspecies and intermediates were identifiable, *as such*, from photographs.

The idea of photographing captured birds came to us in the spring of 1949, when several redpolls continued to visit our feeding station at Northampton, Massachusetts. Most of the birds were Greater Redpolls (*Acanthis flammea rostrata*), but a few were Common Redpolls (*A. f. flammea*). Each bird was weighed when banded and whenever recaptured, and the recorded weights showed the bigger looking birds to be, with few exceptions, the heavier. The 32 Greater Redpolls weighed (in grams) from 13.8 to 22.8 (average: 17.8), the five Common Redpolls from 11.4 to 13.8 (average: 12.9). The Greater Redpolls were definitely the longer-winged and longer-billed; indeed, we found no "birds which had measurable characters of intermediate proportions" (see Shaub, B. M., 1950. *Bird-Banding*, 21: 105–111). Interested in keeping a visual record of some of these differences without collecting, we decided to try photographing the birds, close-up, side by side, in such a way as to obtain strictly comparable pictures.

A major problem was that of holding the birds quiet in one position at exactly the same distance from the lens without in any way injuring them. We soon decided that transparent containers were what we needed. With these no tying down of the wings was necessary, the birds could be placed in any desired position, and shadows and reflections could be kept to a minimum by adjusting the source of light.

Using cellophane of .008 in. thickness, we made cylinders just large enough for each bird, tacking the material in place with transparent cellulose tape. A glass-sided container large enough for two cylinders we made by sawing kerfs in a piece of wood and trimming pieces of glass to fit (see Fig. 1B). The spaces at the ends of the cellophane tubes were not sealed shut, so the birds had plenty

[1] Contribution No. 11 from the Shaub Ornithological Research Station.

of air. In tubes the birds settled down quite satisfactorily. Unable to lift their wings at all, they did no fluttering and almost no kicking or scratching.

Because the birds' head-movements were frequent and unpredictable we used a synchronized flash when making exposures. The camera, on a tripod, was set in a vertical position. The 'tubed' birds, in their container, were placed on a platform and illuminated with the usual tungsten bulbs. The exact position of the container was marked by guides or stops, so as to facilitate replacing it with precision. Frequent removal and replacement was necessary for the position of the birds had to be adjusted. In the container shown in Fig. 1B the end-piece, c, was of glass. Had this been of some dark material, wood perhaps, the birds might not have tried so hard to crawl forward.

When the birds were in exactly the position desired, we pushed the button controlling the flash apparatus. We found it best to hold the reflector in the hand so as to be able to shift the direction of the illumination quickly in making additional exposures.

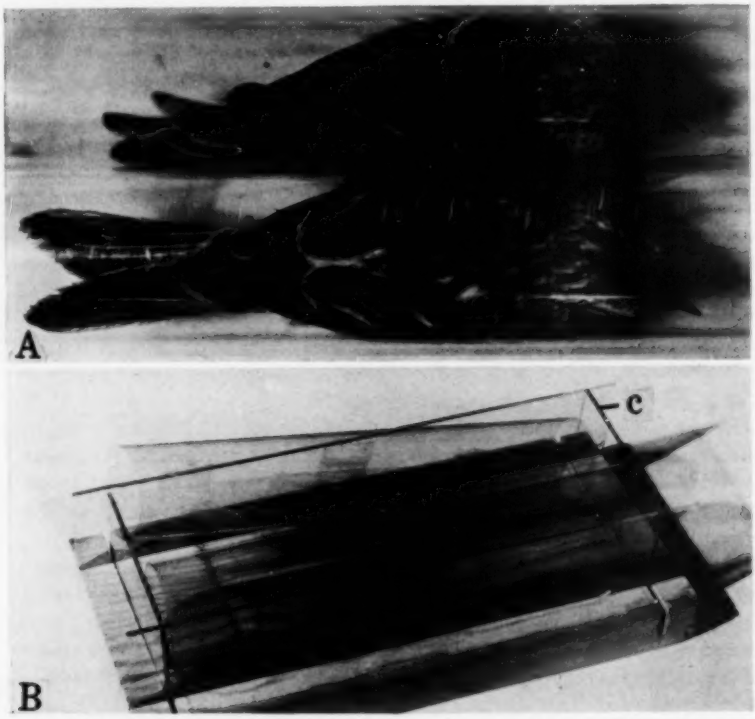

Fig. 1. A. Living redpolls in cellophane cylinders. Above is a Common Redpoll (*Acanthis f. flammea*), below a Greater Redpoll (*A. f. rostrata*). B. Cellophane cylinders and glassed-in container. Photographed March 25, 1949, by B. M. Shaub.

In photographing captured birds in this way the greatest depth of field and sharpness of detail are obtainable through closing the diaphragm opening well down and using a fast shutter speed synchronized to catch the very peak of illumination. Unless this is done the rapid movements of the birds result in blurred negatives.

The cellophane cylinder and cylinder-container described above may not be the best apparatus devisable for this work. Other methods should be tried. Photographs like those made at the Fair Isle Bird Observatory, showing heads, feet, or spread wings of living birds should be taken (see *Wilson Bulletin*, 62: 141–143). If a series of photographs, showing increase in bill-size over a period of years, is to be taken, the method should be worked out with great care so as to make certain in advance that the photographs will be *directly measurable* and strictly comparable. For this sort of record far more than mere sharpness of detail will be necessary: the bill must be strictly in profile, so as to preclude the possibility of any distortion. The bills themselves should be measured too, of course, and the records kept with the photographs.

For records of color-differences, color transparencies should be made. These should be preserved with great care so as to prevent fading.

159 Elm Street, Northampton, Massachusetts

AMENDMENT TO THE CONSTITUTION OF THE WILSON ORNITHOLOGICAL CLUB

An amendment to the Constitution of The Wilson Ornithological Club was proposed by the Executive Council and placed before the membership at the annual meeting on April 27, 1951, at Davenport, Iowa. The proposal was published in the June, 1951, issue of *The Wilson Bulletin*. In accordance with the provisions of the By-laws, the members were asked to vote on this amendment by mail before September 1.

As a result of this ballot, the amendment was adopted, effective October 1, 1951. The amendment eliminates the associate membership class and raises the subscription price of *The Wilson Bulletin* to $3. With this change, the minimum cost of membership becomes $3. Hence, Sections 1 and 3 of Article II of the Constitution now read as follows:

Article II

Membership

Section 1. The membership of this club shall consist of five classes: Active Members, Sustaining Members, Life Members, Patrons, and Honorary Members.

Section 3. The annual dues of Active Members shall be three dollars ($3.00); and of Sustaining Members, five dollars ($5.00). Any member may become a Life Member, exempt from further dues, by making a payment into the endowment fund of the Club of one hundred dollars ($100.00). Any member may become a Patron, exempt from further dues, by making a payment into the endowment fund of the Club of five hundred dollars ($500.00) or more. Upon the unanimous recommendation of the Executive Council, honorary membership may be conferred by the Club by a three-fourths vote at any annual meeting.

TERRITORIAL SONGS OF THE WHITE-WINGED DOVE

BY DOROTHY CHAPMAN SAUNDERS

THE author spent five months in the winter and spring of 1948–49 and five months in the winter and spring of 1949–50 travelling by jeep in México. In connection with other biological work, she made a study of the territorial songs of several male White-winged Doves (*Zenaida asiatica*). She studied these songs principally at four localities—two in eastern México, two in western (see below).

Thirteen songs were formally transcribed—seven songs of the western race, *Z. a. mearnsi*, and six songs of the eastern race, *Z. a. asiatica*. Necessary for the work of transcription was a musical instrument (of known key) which could be carried about easily. The author found an alto recorder (vertical flute) satisfactory. Each song was quickly figured and fingered out, note by note, as the melody was repeated by the bird.

The intervals between certain notes in songs of the White-winged Dove are shorter than the shortest interval commonly used in our musical scale—i.e., that between a note and its sharp or flat. The diagrams presented in Figure 1 give, therefore, only the approximate position on the piano keyboard of the actual sounds. With each diagram are, however, the fingerings used on the alto recorder in determining the true bird sounds, and by repeating these *on the recorder* anyone may ascertain the exact notes. In all diagrams the key of C is used for the piano keyboard transcriptions. The alto recorder is always tuned to the key of F. Customary notations are used for the recorder fingerings. The following data pertain to the songs diagrammed in Figure 1.

A. *Z. a. mearnsi* No. 1. January 5, 1949. Wild bird at Playa de Coyuca, near Acapulco, Guerrero.

B. *Z. a. asiatica* No. 1. December 11, 1949. In cage at Hotel Balneario del Río Pánuco, Tampico, Tamaulipas.

C. *Z. a. asiatica* No. 1. Same date and place as above. This is the common 'short' song, generally phrased as "Who cooks for you?", or "*Que triste estoy*" ("How sad I am"), which all white-wings sing.

D. *Z. a. asiatica* No. 1. December 13, 1949. Same place as B.

E. *Z. a. asiatica* No. 2. Same date and place as B.

F. *Z. a. asiatica* No. 2. December 16, 1949. Same place as B. This song was given at 11 p.m., the lights near the bird cages in the hotel being on at that hour.

G. *Z. a. mearnsi* No. 2. February 12, 1950. Ten miles south of Tepic, Nayarit, at 3200 feet elevation.

H. *Z. a. mearnsi* No. 3. Same date and place as G.

I. *Z. a. mearnsi* No. 4. Same date and place as G.

J. *Z. a. mearnsi* No. 5. Same date and place as G.
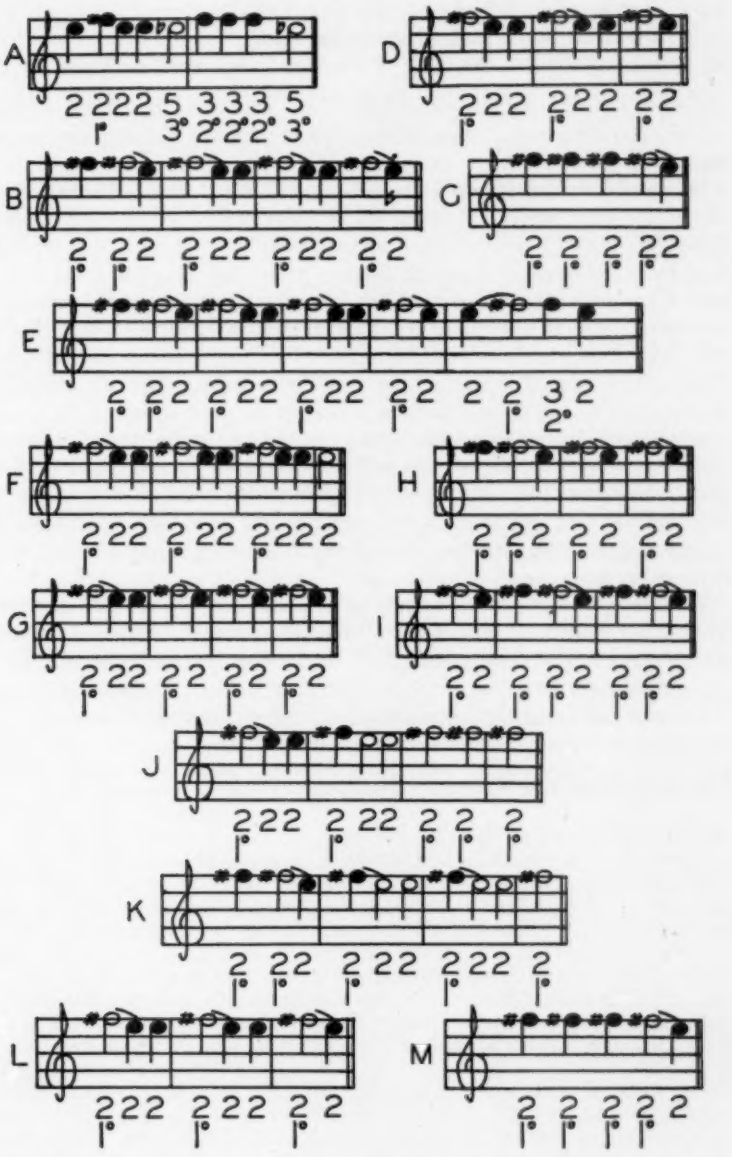
FIG. 1. Transcriptions of songs of the White-winged Dove. For an explanation see page 330.

K. *Z. a. mearnsi* No. 6. Same date and place as G.
L. *Z. a. mearnsi* No. 7. Same date and place as G.
M. *Z. a. asiatica* No. 3. March 26, 1950. Near Valles, San Luis Potosí.

A given song is usually repeated from two to ten times; then, after an interval which varies greatly, the same song, or a variation of it, is repeated two to ten times, etc.

Besides the well known "Who cooks for you?" 'short' song, each male sings long songs which seem to be composed of 'short' songs with individual variations. This is clearly shown in the transcriptions B, C, D, E, and F of songs sung by caged birds at Tampico. Eastern white-wing No. 1 had the 'short' song (C) and three long songs, each being a series of variations of the same general theme. Eastern white-wing No. 2 had a 'short' song identical with that of eastern bird No. 1 and also two long songs, these differing *inter se* and also from the three long songs of eastern bird No. 1. All the songs were, however, obviously related: they seemed to be variations of exactly the same theme.

All the long songs recorded near Tepic, Nayarit, and at the Playa de Coyuca, Guerrero, were, save one, slight variations of the very same theme sung in eastern localities. The exception was a performance transcribed at Tepic: it was identical with one of the long songs sung by an eastern white-wing at Tampico. Each other long song studied was in some slight way different from every other one.

White-winged Dove songs usually have a range of about two full tones. Variations commonly consist in (1) different groupings of the notes; (2) different arrangements of these groups; and (3) different tempos (there may be a very considerable difference in the duration of an individual note). During any one singing (see paragraph immediately following explanation of the diagrams) a variation is repeated over and over without change.

Patuxent Research Refuge, Laurel, Maryland

GENERAL NOTES

Birds new for the Río Grande delta area.—A bird picked up dead near the jetty on Brazos Island by Terry Gill, and brought by him to Harlingen, Texas, on January 28, 1947, I identified as an Audubon's Shearwater (*Puffinus lherminieri*).

A census team composed of William S. Jennings and Luther Goldman, while working on the Harlingen Christmas Bird Census on December 23, 1950, listed "a strange dove of reddish-brown color." The next day Jennings and I went back to the same area and found the bird—quite obviously a Ruddy Ground Dove (*Columbigallina talpacoti*)—with a flock of Inca Doves (*Scardafella inca*). A few days later I accompanied Goldman and Jennings to the Axtla River, in eastern San Luis Potosí, México, where we saw a number of Ruddy Ground Doves. Both men readily agreed that the bird they had seen near Harlingen was in every way identical with those they were seeing in the tropics.

Maurine and Terry Gill showed me a drawing and careful description of a flycatcher which they had observed for some time in a prairie area east of Río Hondo on November 19, 1946. Since it was with a flock of Scissor-tailed Flycatchers (*Muscivora forficata*), and since there were also Mockingbirds (*Mimus polyglottos*) nearby, the Gills were able to make an appraisal of the bird's exact size. From the data supplied me I readily identified it as a Fork-tailed Flycatcher (*Muscivora tyrannus*). This possibility had not occurred to the Gills because the bird had lost so much of its tail that when it flew only one (or what appeared to be one) long streamer trailed out behind. I recall that the first Fork-tailed Flycatcher I ever saw (on the coastal prairie in central Veracruz) had had a similar mishap.

A visitor from New York, Arthur Aranoff, reported a Black Phoebe (*Sayornis nigricans*) on the Resaca del Rancho Viejo near the village of Olmito, Cameron County, Texas, in December, 1947. Later I found the bird and kept watch over it for several months. It disappeared in the spring of 1948 and, so far as I have been able to determine, it has not returned since.—L. IRBY DAVIS, *Box 988, Harlingen, Texas.*

Mexican Cormorant in Oklahoma.—Visitors to Lake Texoma (on the Oklahoma-Texas border, south of Marshall, Love and Bryan Counties, Oklahoma) have, since its impoundment in 1945, occasionally seen cormorants there, most of them Double-crested Cormorants (*Phalacrocorax auritus*) presumably, that being the only species listed by Nice (1931. "The Birds of Oklahoma," Revised Edition. *Publ. Univ. Oklahoma Biol. Surv.*, Vol. 3, No. 1, p. 54) for the state.

In the summer of 1950, I saw cormorants almost daily near the University of Oklahoma Biological Station, some 14 miles south of Madill, Marshall County. Actually, there may have been very few birds, but they flew past so often, or spent so much of their time resting on stubs within plain view, that they seemed to be common. On August 18, I noted groups of four or five repeatedly, and wondered if they might be gathering for migration. The strong south wind made the water rough. The temperature (estimated) at about noon was 90°F.

That day Barbara Wells and I went by motorboat to islands some miles from the Station. Soon after leaving the Station we saw five cormorants perched together on floating logs. About two and one-half miles southeast of the Station, we came upon two more perched on a stub about a hundred yards out from shore. They resembled each other in size. One of them I managed to collect.

The specimen proved to be an extremely fat adult female (ovary distinct, but the ova small). A band of white bordered the gular pouch and there was a sprinkling of fine white feathers on the head and neck. The eyes were green. The skin I placed in the Station's collection.

George M. Sutton, who was on the Station staff in the summer of 1951, called our atten-

tion to the bird's smallness and expressed his belief that it was a Mexican Cormorant (*P. olivaceus*). After comparing it recently with several female *auritus* and *olivaceus* he has identified it as the latter. Its bill measures only 45 mm. (base of culmen across to tip); its tail, 161. Only seven of its rectrices are of full length, but otherwise it seems to be in full breeding plumage. Since the bird I saw with this female appeared to be of about the same size, I think it must have been a Mexican Cormorant too. The species has not heretofore been reported from Oklahoma.—KENNETH J. STARKS, *Department of Zoological Science, University of Oklahoma, Norman.*

Great Blue Heron killed by Bobcat.—While ascending the Colorado River in an outboard motor boat, at Devil's Elbow in Havasu Lake National Wildlife Refuge on January 8, 1951, Leo K. Couch and I saw a Bobcat (*Lynx rufus*) catch a Great Blue Heron (*Ardea herodias*). At about five o'clock in the afternoon, when the canyon was already in shadow, the heron flushed from the Arizona side and flew across to the California side. It began struggling as it alighted on the rocky bank, as if its foot had been caught in a trap. At this juncture, the motor ran out of fuel and the boat stopped, so we looked at the bird with our binoculars. To our surprise, we saw that a large Bobcat had grasped it by its under side at the lower end of the neck. The cat turned its head to regard us for a few seconds, then began dragging its prey up the bank. It had some difficulty in doing this, as it stepped on the outstretched wings. In less than a minute it reached the top of the bank and disappeared behind a ledge. We deduced that it had been in a small cavelike hideout along the bank and that it had sprung as the heron, wholly unaware of its presence, had attempted to alight. As far as I know, the capture of the Great Blue Heron by the Bobcat has not hitherto been reported.—GALE MONSON, *Fish and Wildlife Service, P.O. Box 1717, Parker, Arizona.*

Feeding behavior of young American Bitterns.—In the spring of 1950 not far from Ann Arbor, Washtenaw County, Michigan, I found the nest of an American Bittern (*Botaurus lentiginosus*) in a small marsh. There were four eggs. The bird at the nest, presumably the female, refused to leave, so I caught and banded her (Biological Survey No. 35541942). Then I set up a blind seven inches from the nest. During the period of my observations from this blind (June 10 to 25 inclusive) the banded bittern was the only adult to appear at the nest. She swelled out her feathers and growled like a broody hen when I approached or left the blind, and pecked with such speed and finesse that she brought the blood repeatedly while I was counting the eggs under her. As long as I stayed in the blind, however, she paid little attention to me.

The first chick hatched shortly before 6:30 a.m. on June 11. The second had hatched by 2:50 p.m. that same day. The third hatched on June 13. One egg did not hatch. The feeding behavior differed in some respects from that reported by Gabrielson (1914. *Wilson Bulletin*, 26: 64), who described the feeding of several-day-old bitterns large enough to swallow fish, frogs, mice, etc., as they were regurgitated whole by the parent.

When twenty-four hours to eight days old, the chicks I observed jumped at the parent's bill and attempted to seize it in the manner described by Mr. Gabrielson; but they could seldom cope with the large chunks of food which fell into their bills, so this food often dropped to the nest. After the parent had regurgitated her store of food animals, she re-swallowed those which the young would not manage to get down, and presented this food later when partial digestion had made it more acceptable. The period of waiting varied from twelve to forty-five minutes—depending on the eagerness of the chicks as well as on the size of the food items. On two occasions the hungry chicks squeaked and jumped at the parent's bill so persistently that she regurgitated food before it was 'done' and she had to swallow it again.

Table 1 lists all of the food I saw the parent bittern bring to the young during their first seven days. I could not spend much time in the blind, so what I saw the parent bring was

TABLE 1

FEEDING BEHAVIOR OF THREE YOUNG AMERICAN BITTERNS

Date	Observation Period	Activities at Nest	Success of Feeding
June 11	6:30–8:45 a.m.	Parent brooded chick	No food offered
	2:50–3:45 p.m.	At 2:55 parent arrived; chicks became restless and squeaked	No food offered
June 12	4:45–7:00 a.m.	Parent on nest; chicks quiet	No food offered
	3:13–4:30 p.m.	Chicks restless under parent until, at 3:44, she regurgitated 4-inch fish	Fish too large for chicks, so parent re-swallowed it
June 13	4:00–5:10 p.m.	Parent brooded chicks; chicks squeaked softly from time to time	Continuous rain probably led parent to continue brooding
June 14	10:50 a.m. to 12:32 p.m.	At 11:26 parent arrived and settled on restless chicks	No food offered
		At 12:10 parent regurgitated 7-inch salamander and 3-inch fish	Chicks could not swallow either salamander or fish so parent re-swallowed them
		At 12:22 parent regurgitated above-named items again	Chicks got them down
	3:45–5:10 p.m.	Chicks slept until parent returned at 4:40. At 4:48 she regurgitated 4-inch fish	Fish too large for chicks so parent re-swallowed it
		At 4:48, parent regurgitated two partly digested frogs	Two chicks each promptly swallowed a frog
		At 5:10, parent regurgitated 4-inch fish again	Fish still too large, so parent re-swallowed it
June 16	2:45–3:50 p.m.	At 2:45 parent regurgitated two frogs—one partly digested, the other entire	Partly digested frog stuck in chick's throat; whole frog also too large
		At 2:46, parent regurgitated shapeless gob, probably a much-digested frog	Chick swallowed gob; parent re-swallowed two frogs, taking one from chick with some difficulty
		At 3:29, parent regurgitated two frogs again	Chick promptly swallowed one frog; another chick failed to swallow second frog; parent swallowed this frog again
June 17	7:30–8:40 a.m.	Parent brooded restless chicks until 7:55, when she regurgitated a 4-inch fish and a jumping mouse	Fish too large for chick, but mouse promptly swallowed. Parent re-swallowed fish
		At 8:40, parent regurgitated 4-inch fish again	Fish promptly swallowed by chick
	8:10–9:10 p.m.	Parent brooding; chicks quiet	

presumably only a small part of the total brought.—Esther (Mrs. George) Byers, *University of Michigan Museum of Zoology, Ann Arbor.*

Frigate-bird, Oystercatcher, Upland Plover, and various terns on the coast of Tamaulipas, México.—While studying and collecting vertebrates in the State of Tamaulipas, México from February 15 to June 15, 1949, we made three brief trips to the coast. From April 27 to 29 we visited the Barra Trinidad region, 8 miles north of the village of Morón. We could not stay longer because of lack of fresh water there. On April 25 and May 2 we visited the beach at Miramar, near Tampico. On May 9, Robins and Heed visited the village of Tepehuaje, some 20 miles south of Pesca and 80 miles north of Tampico (see World Aeronautical Chart No. 589, Tamiahua Lagoon Sheet, village of Tepehuaje de Arriba). Our base-camp at that time was 10 miles northeast of Zamorina, and the trip to the coast meant a 25-mile jeep ride over oil-prospecting trails.

Some of the birds we encountered on the coast are of special interest either because they have never actually been reported from Tamaulipas or because no one has found them breeding there. One of the latter category, the Willet (*Catoptrophorus semipalmatus*), George M. Sutton has already discussed (1950. *Condor*, 52: 135–136). The following also merit comment:

Frigate-bird, *Fregata magnificens*. Present in large numbers in the Barra Trinidad region. Most evident in the morning and in the evening dusk, when they did considerable soaring. During the afternoon they remained on the brush- and tree-covered shore of a large bar. They may have been nesting there, but we were unable to cross the lagoon to investigate. An immature male specimen taken at Tampico on April 23, 1923 (University of Michigan Museum of Zoology, No. 58976), has been identified by Pierce Brodkorb as *F. m. rothschildi*. Friedmann, Griscom and Moore (1950. "Distributional Check-List of the Birds of México," *Pacific Coast Avif.* 29) do not list Tamaulipas among the states from which this species has been recorded.

Oystercatcher, *Haematopus ostralegus*. Robins and Heed saw three Oystercatchers on the beach near Tepehuaje in company with Wilson's Plovers (*Charadrius wilsonia*), Black-bellied Plovers (*S. squatarola*), Willets, Turnstones (*Arenaria interpres*), and Sanderlings (*Crocethia alba*). Friedmann, Griscom and Moore (*op. cit.*, p. 89) state that this species is "to be sought in the lagoons of northeastern Tamaulipas."

Upland Plover, *Bartramia longicauda*. One was frightened by the approaching jeep from a grassy woodland road near a small village between our Zamorina camp and the coast, May 10.

Sandwich Tern, *Thalasseus sandvicensis*. Robins and Heed clearly saw two of these terns on the beach near Tepehuaje in company with one Royal Tern (*T. maximus*), several Black Terns (*Chlidonias niger*), and some Least Terns (*Sterna albifrons*). Near Barra Trinidad we saw ten Royal Terns on the beach and many more flying about the lagoon.

We wish to point out that, during the dry season at least, the coast from Pesca to Tampico is more easily accessible than is generally believed. At least one fishing company runs trucks regularly from Pesca to Tampico along a coastal route which we saw and used at Tepehuaje and, farther south, from El Sabino to Aldama.—C. Richard Robins, *Department of Conservation, Cornell University, Ithaca, New York;* Paul S. Martin, *University of Michigan Museum of Zoology, Ann Arbor;* and William B. Heed, *University of Texas Department of Zoology, Austin.*

Unusual water birds in Rockbridge County, Virginia.—In three previous papers in *The Wilson Bulletin* (1935, 47: 59–67; 1937, 49: 48–49; 1940, 52: 280–281) I listed 61 forms of water birds recorded in this Virginia mountain county. Two of these were supposed races of the Black Duck, but since 'Red-legged Black Ducks' are now believed to be merely highly colored individuals, only *Anas rubripes* should be listed. This brings the list to 60 forms, as of December, 1940.

Recently I published notes on four additional birds: the Lesser Snow Goose, *Chen h. hyperborea* (1950. *Auk*, 67: 233–234), Blue Goose, *Chen caerulescens* (*ibid.*), Stilt Sandpiper, *Micropalama himantopus* (1948. *Auk*, 65: 607), and Caspian Tern, *Hydroprogne caspia* (*ibid.*). The following six species (five of which are new for Rockbridge County) I wish to record here. The total list of water birds for the county now numbers 69 forms.

Yellow-crowned Night Heron (*Nyctanassa violacea*). Colonel and Mrs. Gordon Heiner saw an adult at a small stream in their yard on the edge of Lexington, July 26, 1950. They gave me an accurate description and an easily recognizable drawing of the bird.

Least Bittern (*Ixobrychus exilis*). On September 4, 1948, I observed a bright yellowish brown female at close range at Cameron's Pond, one mile from Lexington. The bird remained there for three days.

Turnstone (*Arenaria interpres*). Robert Paxton saw one in bright summer plumage at the Womeldorf fish pond, August 28, 1949.

Red-backed Sandpiper (*Erolia alpina*). I saw one in bright breeding plumage at Cameron's Pond on May 29, 1950.

Stilt Sandpiper (*Micropalama himantopus*). One which I saw at Cameron's Pond on October 13, 1947, I have already reported (1948. *Auk*, 65: 607). I saw a Stilt Sandpiper at the same place September 22 to 30, 1948.

Sanderling (*Crocethia alba*). One appeared at the Womeldorf fish pond on August 20, 1950, at a time when a hurricane was moving up the Atlantic coast. I collected it August 21. It was a male in first winter plumage. Apparently this is the first inland record for the Atlantic States between Washington, D. C., and Aiken, South Carolina.—J. J. Murray, *6 White Street, Lexington, Virginia.*

Bicolored Hawk in Tamaulipas, México.—An exceptionally beautiful adult female Bicolored Hawk (*Accipiter bicolor*) was shot by a Mexican hunter on August 16, 1950, in heavy forest along the foot of the Sierra Madre Oriental near the Río Sabinas about five miles north of the town of Gómez Farías, southwestern Tamaulipas, México. Circumstances of the capture are interesting. Shortly before August 16, a pair of jaguars (*Felis onca*) with two half-grown cubs had been seen in the forest just upslope from the Sabinas sugar cane fields, and the female shot. When, on the 16th, a party returned to collect the skull of the jaguar and search for the male and cubs, they chanced to see this hawk perched quietly in the dark woods. Vegetation in this area resembles that of the tropical evergreen forest of Leopold (1950. *Ecology*, 31: 507–518), here found as a narrow belt along the base of the Sierra Madre. This habitat apparently marks the northern distributional limit of many distinctly neotropical plants and animals, including *Accipiter bicolor*.

My friend William B. Heed, now a graduate student at the University of Texas, prepared the specimen with great care, making important label comments. The ovary was paired, the whole mass measuring about 12 x 4 mm., the largest ovum being about 1 mm. in diameter. The legs, feet and eyelids were yellow, the eye bright red, the cere dark. The outermost primary was very short (about 65 mm.), the basal half still being sheathed.

The specimen is, apparently, the first for Tamaulipas. It represents the race *fidens*, described from the State of Veracruz. The upper parts are blackish slate, darkest on the top of the head and tail. The under parts, except for the white crissum and rufous flags, are slate gray, each feather having a fine grayish black shaft-line. Some of the median plumage, especially of the throat and lower belly, is light gray basally. The wing measures 254 mm. (primaries pressed flat), the tail 208, the tarsus 72, the culmen (from cere) 19.5. The specimen is No. 11068 in the Sutton collection.—Paul S. Martin, *University of Michigan Museum of Zoology, Ann Arbor.*

A nest of the Rufous-breasted Spinetail in México.—The Rufous-breasted Spinetail (*Synallaxis erythrothorax*) is a not very noticeable furnariid found from Veracruz, Yucatán,

and Chiapas southward to northwestern Honduras and El Salvador. It is a thicket bird about six inches long, with a quiet, four-noted call.

While collecting birds along the Río Atoyac at Ojochico, a few miles east of Córdoba, Veracruz, in mid-April, 1947, we found a nest of this spinetail about four feet above the ground in a thicket at the base of a hill just west of the cane plantations of the Potrero sugar mill. Externally the nest was composed entirely of rather long, slender twigs, sturdily inter-

Nest of Rufous-breasted Spinetail (*Synallaxis erythrothorax*). Photographed in mid-April, 1947, near Córdoba, Veracruz, by Robert B. Lea.

locked. It was, as can be seen in the accompanying photograph, completely domed over. It was about eighteen inches long and ten inches in diameter at the large end. The entrance was at the small end, and the bird passed through a narrow tunnel in reaching the nest chamber at the large end.

We frequently heard and saw an adult spinetail near this nest. Occasionally we saw a bird (sex ?) going in, but so far as we could tell neither incubating of eggs nor brooding of young was going on there. An adult male which we collected about fifty feet from the nest on April 19 had enlarged testes (each about 6 x 5 mm.).—ROBERT B. LEA, *Charity Hospital, New Orleans, Louisiana*, and ERNEST P. EDWARDS, *Third Chemical Mortar Bn., Ft. Bragg, North Carolina*.

An egg of the Umbrella Bird.—The eggs of many species of the family Cotingidae have never been described. The eggs are rare in collections and identification of some specimens is open to question. Virtually nothing is known about the nidification of the famous Umbrella Bird (*Cephalopterus ornatus*). E. Pöppig's statement (1831. Pugillus descriptionum ad Zoologiam Americae australis spectantium. Supplement to *Frorieps Notizen aus dem Gebiete der Natur und Heilkunde*, Number 681, Vol. 31) that the clutch consisted of two eggs was based on local hearsay and was not accompanied by a description. Pöppig's account was repeated by Burmeister (1856. "Systematische Übersicht der Tiere Brasiliens," Vol. 2, Aves).

I secured a clutch of *C. o. ornatus* on July 25, 1949, in Matto Grosso, Brazil, on the Upper Río Xingú, in the region explored by the Fundação Brasil Central. The nest contained only one egg—the normal set according to the testimony of the Juruna Indians. The egg is oblong and rather pointed at one end. It measures 56.0 x 35.8 mm. The empty shell weighs 2.1 grams. The shell is khaki-colored, spotted with light chocolate and purplish brown and lightly stippled with dark brown. The shell has little gloss.

Further details concerning the biology of the Umbrella Bird I plan to communicate later.—HELMUT SICK, *Fundação Brasil Central, Avenida Nilo Peçanha 23, Rio de Janeiro, Brazil.*

***Empidonax albigularis* in southwestern Tamaulipas.**—One of the most interesting specimens in the bird collection obtained for me by E. K. Miller and J. H. Poppy in the Gómez Farías region of southwestern Tamaulipas in the summer of 1948 is a male White-throated Flycatcher, *Empidonax albigularis*, collected July 21 on the foothill above the Río Sabinas, at an elevation of about 3500 feet, half a mile south of the Rancho del Cielo. To the best of my knowledge, *E. albigularis* has not been taken in Tamaulipas before.

The specimen is similar to four *albigularis* from Michoacán in my collection, but less brown in tone throughout. The sides of the head, the chest and flanks, and especially the wing-bars, remiges edgings, and under tail coverts are almost without brown or buff. The crown, hind neck and back, too, are largely devoid of brown, though a slight staining of the back plumage makes color comparisons involving this region difficult. A notable feature is the darkness of the middle and greater wing coverts. The tips of these feathers are grayish white, in rather sharp contrast to the blackish brown basal part.

This Tamaulipas bird is so different from any of the ten *albigularis* (four from Chiapas, four from Michoacán, one from Costa Rica, one from Durango) before me that I suspect it belongs to an undescribed race. It is closest, apparently, to the Durango bird, a male taken by Paul S. Martin near the village of San Luis, at an elevation of about 8500 feet, 16 miles west of the Laguna del Progreso, on July 8, 1950. This Durango specimen (wing, 63 mm., tail, 54) I have identified as *E. a. timidus*. According to label-comment it was "singing in willows along a stream in open meadows." This habitat, as well as the general appearance of the specimen, suggest close affinity to *E. trailli*.

The Tamaulipas specimen of *albigularis* weighed 11 grams. According to label comment its eyes were dark brown, its mouth yellow, its lower mandible "pale yellow," and its feet black. The wing measures 64 mm., the tail 56. It is much less frayed and faded than the Durango specimen, whose wing-bars have almost disappeared through wear.—GEORGE MIKSCH SUTTON, *University of Michigan Museum of Zoology, Ann Arbor.*

September nesting of the Barn Swallow in Arizona.—O. S. Pettingill, Jr., (1946. *Wilson Bulletin*, 58: 53) has reported young Barn Swallows (*Hirundo rustica erythrogaster*) still in the nest as late as September 24, 1945, at Regina, Saskatchewan (about 50° 30′ N. Lat.). The record calls to mind a late nesting I observed at Springerville, Apache County, Arizona, in September, 1934. Springerville is at the northeastern base of the White Mountains, in central-eastern Arizona, at an elevation of 6,965 feet. On September 16 of that year, in a barn in town, Randolph Jenks and I found a Barn Swallow's nest containing three young birds and an addled egg. The young were at least two weeks old. Two of the young, on being frightened from the nest, flew distances of 20 and 50 yards, respectively, from the barn. This was their first flight. We returned the two birds to their nest. On September 21, we saw the adult swallows feeding a young one perched on a rafter in the barn. On September 27, we saw two adult swallows flying inside the barn, but we failed to find any of the young.

Flocks of from 20 to 40 Barn Swallows were noted almost daily in and near Springerville throughout September—as late, in fact, as October 2. So far as I know, none was observed between that date and October 23, when I left the region. Whether the young birds mentioned

above started the southward migration with their parents is, of course, problematical.—J. O. STEVENSON, *U. S. Fish and Wildlife Service, Washington, D. C.*

Black Robin in Tamaulipas, México.—The late winter of 1951 was marked by the severest freeze in the memory of most residents of northeastern México. Heavy frosts in early February killed or damaged tropical vegetation on the Atlantic slope at least as far south as Jacala, Hidalgo. My friend Frank Harrison, of the Rancho del Cielo, five miles northwest of Gómez Farías, Tamaulipas, generously supplies the following data on minimum temperatures recorded by him during this period: February 1, −6°C.; February 2, −4°; February 3, −2°, with snow in the morning. During the extremely dry weather following the freeze, Mr. Harrison attracted many birds, including flocks of twenty to thirty Blue-hooded Euphonias (*Tanagra elegantissima*), to pans of water. In late February he collected an unfamiliar dark bird which he saw feeding on mulberries in his clearing. The specimen proves to be a subadult male Black Robin (*Turdus infuscatus*). Its measurements are: wing, 129 mm.; tail, 98; culmen, 20.5; tarsus, 26. The bill and feet must have been bright yellow in life for even in the dried specimen (now in the Sutton collection) they are pale yellowish brown.

Dominant trees in the Rancho del Cielo cloud forest (elevation 1200 meters) are the sweet gum (*Liquidambar styraciflua*), oaks (*Quercus* spp.), *Magnolia schiedeana*, and *Podocarpus Reichei*.[1] Among the more common breeding birds are the Singing Quail (*Dactylortyx thoracicus*), Mexican Trogon (*Trogon mexicanus*), Green Jay (*Xanthoura yncas*), and Black-headed Nightingale-Thrush (*Catharus mexicanus*).

During parts of April, May and June of 1948 I spent five weeks collecting birds in this region, but only once, in late April, did I see what appeared to be a Black Robin. On that occasion a dark, robin-size bird went skulking through the heavy forest about a mile from Mr. Harrison's clearing. Since then several observers, especially Byron Harrell of the University of Minnesota, have devoted many weeks to study of cloud forest birds thereabouts without encountering *Turdus infuscatus*. The species apparently has not heretofore been reported from Tamaulipas. The extreme cold spell and equally severe drought may have been responsible for the species' appearance.—PAUL S. MARTIN, *University of Michigan Museum of Zoology, Ann Arbor.*

[1] For a brief account of the vegetation in this unique Tamaulipas habitat, see Sharp, *et al.*, 1950, *Soc. Botánica de México Bull. No.* 11, p. 1–4.

EDITORIAL

Every purposeful ornithologist has filing problems. Letters, scribbled notes, newspaper clippings, work sheets recording measurements and color comparisons, excerpts from notebooks—all these must be kept in order if they are to be useful.

Some folders in an 'active file' are not, admittedly, opened from the year's beginning to its end. This is not surprising in view of the fact that Black Rails keep themselves hidden most of the time and some correspondents do not correspond. Other folders, however, are consulted almost every day. Among the most remarkable of this category in our file are four which have been put away from time to time but refuse to become inactive. In one of these are explicit directions for loading shells, reaming out auxiliary barrels, repairing shotgun stocks, cutting wads, and knocking out old primers. That folder bears the name Semple, John B. In another is a sheaf of yellow sheets with scribblings concerning the subspecific identification of Mexican birds—references to type specimens examined in European museums, to personal observations in El Salvador, Sonora, and a hundred other places, to correspondence with Stresemann, Hellmayr and Berlioz. That folder bears the name van Rossem, A. J. A third holds letters both typewritten and long-hand outlining enough ornithological projects to keep a man busy for a lifetime, and with these effervescent suggestions amusing discussions of persons in the public eye, reminiscences brimming with good humor, and references to happy hunting grounds full of marshes. This one bears the name Peet, Max Minor.

The fourth does not hold much. But the letters there, all long-hand, are so full of vigor, good spirit and encouragement that reading them is a tonic. The folder bears the name Nunnemacher, Gertrude A.

This issue of *The Wilson Bulletin* is a memorial to Gertrude Nunnemacher. Those who made possible the memorial were her husband, Henry J. Nunnemacher, and the following members of the Bird Group of the Milwaukee City Club: Myrtle Baer, Mr. and Mrs. A. P. Balsom, Mrs. A. C. Bromm, Mrs. F. Bunkfeldt, Mrs. H. K. Coen, Mrs. M. Cutler, Mrs. C. R. Decker, Jr., Mary Donald, Susan Drake, Mrs. J. Freede, Mrs. L. B. Goodrich, Mrs. M. D. Hartley, Dr. Anna Hehn, Mrs. Blanch Hibbert, Mrs. W. F. Jackson, Mrs. T. L. Kelley, Mrs. Bruno Kroetz, Mrs. Hugo Kroetz, Mrs. C. A. Lind, Mrs. Lillian Logemann, Isabel Miller, Mr. and Mrs. Martin Paulsen, Mrs. Gustave Reuss and daughter, Mrs. Carl Schwendener, Mrs. Amelia Simmons, Mrs. L. C. P. Smith, Helene Stoll, Leo Tiefenthaler, Dr. Pearl Thompson and Mrs. E. R. Weber.

The Bird Group of the Milwaukee City Club had its beginnings in late April, 1926. An informal body at first, it sponsored several spring and summer field trips and some discussion meetings. In November, 1926, it was formally organized and membership was thrown open to both members and non-members of the City Club. Mrs. Nunnemacher was elected the first Secretary. On May 27, 1927, the first 'May Day Census' was taken, a total of 85 bird species being seen by those participating. This census was to become an annual event. On Mrs. Nunnemacher's return from Europe in 1930 she was elected Vice-Chairman, an office she held until 1941, when she became Chairman. The Group celebrated its twenty-fifth anniversary on November 18, 1951. There are now 25 members, seven of whom were active members in 1926.

John G. Williams, of the Coryndon Museum, Nairobi, Kenya Colony, East Africa, has very generously offered his assistance to any member of the The Wilson Ornithological Club fortunate enough to visit Africa. Because of Mr. Williams' extensive field experience in East Africa, he can give excellent advice on safari itineraries, localities where special birds may be seen or collected, and similar matters.

Mr. Williams has almost completed a monograph on "The Sunbirds of Kenya Colony." This work contains an illustrated key to the genera of sunbirds recorded from Kenya Colony, and discusses the distribution, field characters, and habits of all species and subspecies found there. It will be illustrated by ten color-plates; by many photographs of sunbirds and their nests and eggs; and by distribution maps. The publishers, Longmans, Green & Co., Ltd., of Nairobi, are much interested in finding out how large a sale may be expected in America. Persons desiring more information about the book should write Dr. Berger or Mr. Williams.

The many friends of Helmuth O. Wagner, a member of our Club since 1945, will be glad to know that his interest in Mexican birds continues. A little over a year ago he moved from Mexico City to Bremen, Germany, there to become the Director of the Museum für Natur-, Völker- und Handelskunde; but he has recently finished a life history of the White-eared Hummingbird, a species he saw much of in México, and a paper on the Cracidae of Chiapas. Dr. Wagner is sorely missed on this side of the Atlantic. While residing in México he often helped friends from the United States in finding their way about; joined them in their field work; or visited remote areas in order to obtain specimens needed by them. His knowledge of field-techniques, his ability as a linguist, and above all his abounding energy and good spirit made him an invaluable ally, no matter what the problem or occasion.

A book, to be compiled from the many writings of Althea R. Sherman, for much of her life a devoted member of our Club, will contain certain articles which first appeared in *The Wilson Bulletin*. The book, to be titled "Birds of an Iowa Dooryard," will be compiled by Fred J. Pierce, the editor and publisher of *Iowa Bird Life*.

The Hamilton Nature Club, of Hamilton, Ontario, has been granted permission to reprint in their journal, *Wood Duck*, "The Persecution of Predaceous Birds," by William H. Elder and Charles M. Kirkpatrick, an article which appeared in a recent issue of *The Wilson Bulletin*. The Club, whose president is Robert O. Elstone, is to be commended for this lively interest in protection of the birds of prey.

Bruce Campbell, Secretary of the British Trust for Ornithology, informs us that the address and registered office of the Trust is now 2 King Edward Street, Oxford, England. Certain publications of the Trust have recently been reviewed in our *Bulletin*.

A law now in force in Connecticut forbids the killing of any hawk or owl except when it is caught in the act of molesting poultry. This is a marked improvement over the old, weak law that left most birds of prey unprotected. Since so few can tell one hawk from another, the law seems better than one which designates certain species as harmful and therefore unprotected. The dangers of omitting protection for certain species of predators, or of trying to reduce their numbers, are well illustrated by the results of the Pennsylvania bounty on the Goshawk some years ago, when a high proportion of the birds presented for bounty payment were not Goshawks—or even accipiters.

The passage of this law should prove encouraging to conservationists in other states, not only the six which have no protective laws whatever for birds of prey, but also the many which provide incomplete legal protection. Connecticut is not a state where in the past all local groups interested in conservation in general and birds in particular have been closely organized for common action. After *Audubon Magazine* mentioned the scant protection afforded birds of prey in Connecticut, the Westport Audubon Society, under the enthusiastic leadership of Mrs. Harry Long, introduced a bill and notified conservation groups all over the state of the need for support. The combination of a sound measure and this enthusiasm proved effective.

The new law does not of itself guarantee protection for birds of prey in Connecticut. There

were no points in the state, apparently, at which concentrations of migrating hawks furnished regular targets for gunners—as they once did at Hawk Mountain in Pennsylvania. The birds have been killed all over the state, in small numbers on any one day, making enforcement of the new law more difficult than it would be at hawk concentration points. From now on, however, fewer owls will be killed merely because their calls keep someone awake, and taxidermists should no longer handle dozens of trophies for the mantelpiece. However, the type of hunter who, out of ignorance or boredom, shoots cormorants from a duck blind, is still a menace to all birds of prey. As discussed in the June issue of *The Wilson Bulletin* (pp. 138–140), protective statutes mean little unless the general public is sympathetic, and the larger part of our task in Connecticut remains to be done.—E. Alexander Bergstrom.

The organization of a group to promote zoölogical studies in the New World tropics is well under way at Ann Arbor, Michigan. To be known as "The Foundation for Neotropical Research," this organization hopes soon to begin limited subsidization of both technical and semi-popular projects, not necessarily limited to birds, in the American tropics. Funds toward this objective are already accumulating through the advance sale of a limited edition of paintings of Mexican birds soon to be published. More detailed information from the new Foundation, whose present headquarters are the University of Michigan Museum of Zoology, may be expected in the near future.

The Wilson Bulletin color plate fund has continued to grow in recent months in a gratifying manner. The most important augmentation was brought about by the auction of original bird drawings and paintings held at the Davenport, Iowa, meeting, at which exactly four hundred dollars came into the fund. The Club is deeply grateful to the bird artists who generously contributed their work: W. J. Breckenridge, R. P. Grossenheider, F. L. Jaques, O. J. Murie, R. T. Peterson, and G. M. Sutton; to Robert M. Mengel, Chairman of our Illustrations Committee, who managed the affair so well; to Dwain Warner and others who proved themselves so able as auctioneers; and to Jane Mengel and Jean Tordoff, who displayed the pictures so decoratively. A matter of regret is that several pictures sent on by T. M. Shortt, to whom we extend our thanks, did not arrive in time. Worthy of special mention also is Hazel Bradley, of Jackson, Michigan, who contributed substantially to the fund after failing to obtain a single picture in the vigorous bidding. We hope that such auctions will continue to be a feature of our meetings; besides helping with the color plates, they enable all members to obtain attractive originals for their own permanent enjoyment.

In June, 1951, the first five Frank M. Chapman Memorial Fellowships were awarded by the American Museum of Natural History. The amount distributed was $1950, and the recipients and their projects were: 1. Richard B. Fischer, Cornell University. A study, based upon banded birds, of the reproductive behavior of the Chimney Swift in central New York State. 2. Byron F. Harrell, University of Minnesota. Faunal and ecological investigations of birdlife in southern Tamaulipas, México. 3. Owen A. Knorr, Colorado College. Life history studies of the Northern Black Swift in the Rocky Mountains. 4. Mrs. Robert Schultz, University of Washington. Continuation of a study of the life history of the Glaucous-winged Gull. 5. David K. Wetherbee, Clark University. The pterylosis of North American birds.

Additional fellowships may be awarded in the spring of 1952. In general, student investigators will be given preference over candidates already possessing wide prestige. Applicants should clearly state their problems and their qualifications and be sponsored by one or more of their professors. Applications should be addressed to the Frank M. Chapman Memorial Committee, American Museum of Natural History, Central Park West at 79th Street, New York 24, New York. Applications should be received not later than January 31, 1952, in order that decisions may be made well in advance of the summer vacation period.

The Michigan Audubon Society has blazed an important trail. Realizing that nature counsellors in summer camps often need to know more about nature than they do, the Society instituted, this past summer, a Nature Counsellors' camp. The week of June 17 to 22 (just before the opening of most summer camps) and Camp Mahn-Go-Tah-See, near Hale, Michigan, were selected as the time and place. Four members of the Society, all teachers, made up the staff. One of the four, Homer D. Roberts, the Society's President, acted as Director. The others were Almeda Boulton and Wilson Club Life Members Hazel Bradley and H. Lewis Batts.

Enrollment came about through contact with Y.M.C.A. camp directors and the Michigan Campers' Association. Nineteen camps sent representatives, paying their expenses. Other persons attended, paying their own way. The counsellors, divided into groups, attended half-day outdoor sessions, studying birds, insects, minerals, weather, plants, and water-life. Evening sessions were devoted to stars, conservation laws, and nature games. There were three early morning bird-walks.

Plans for another such camp in June, 1952, are already under way. The Society is to be congratulated upon seeing so clearly how this great work may be a means of spreading nature education, and therefore of sound conservation concepts, to countless young people in Michigan.

In the death, on June 1, 1951, of Southgate Yeaton Hoyt the cause of ornithological education lost a devoted ally and our Club an unusual member. Born January 13, 1913, in Baltimore, 'South' was interested all his life in the imparting of biological knowledge. As an undergraduate at Washington and Lee; as an assistant to William Beebe in Bermuda in 1935; as a visitor to Europe in 1938 (he attended the International Ornithological Congress at Rouen, France, that year); as director of nature study at the Cold Spring Harbor Biological Laboratory in the summers of 1941, 1947, 1948, and 1950; and as a member of the Cornell University and Sampson College faculties, he was interested primarily in teaching. In the spring of 1942 he married Sally Foresman. That year he began 42 months of service with the Army Medical Corps. In 1945 he returned to Cornell. On completing a study of the Pileated Woodpecker in 1948 he was awarded the Ph.D. degree. In 1949 and 1950 he was especially active in teaching youngsters about birds. Many local schools listened regularly to his radio programs. His refusal to complain, despite his painful illness, was a marvel to all who knew him.

The Club's Research Committee has voted to award the Edward L. Chalif Grant for Bird-Work in México to Byron E. Harrell, who is studying the ecology of the Rancho del Cielo forestlands in southwestern Tamaulipas. Mr. Harrell and Dwain W. Warner, Curator of Birds at the Minnesota Museum of Natural History, left for Mexico in November.

The Local Committee for the thirty-third Annual Meeting of our Club at Gatlinburg, Tennessee is composed of Arthur L. Stupka, Chairman, Albert F. Ganier, Joseph C. Howell and James T. Tanner.

The editors are grateful to the following for assistance in preparing for publication the material presented in this issue: William H. Allen, Burton L. Baker, William L. Brudon, Esther Byers, Theodore H. Hubbell, William A. Lunk, Rogers McVaugh, James L. Peters, Haven H. Spencer, Kenneth J. Starks, Charles F. Walker and Albert Wolfson. Realizing that this issue of the *Bulletin* is their last, they take this opportunity to thank especially Elsa Hertz, who has, during their tenure as editors, re-typed literally hundreds of pages of manuscript so as to give them clean copy; William Lunk, who has given edited manuscripts a final going-over just before their being sent to the printer; J. Van Tyne, who has furnished lists of additions to the Club Library; William Brudon, who has 'sharpened up' diagrams with his expert brush; and Betty and Powell Cottrille, who have given financial aid from time to time.

LETTER TO THE EDITOR

This is a reply to those who have taken issue with ideas expressed in my paper, "Convergence in American Orioles." The criticisms of my arrangement and the counter proposals by G. G. Williams (*Wilson Bulletin*, 63: 52–54) are based on the importance he assigns to the plumage of female and young birds. He claims it is "axiomatic" that this be taken prominently into consideration in making any phylogenetic arrangement.

The facts do not appear to support Williams' assumption that this plumage represents the true genetic picture of the species. Sex-inversion experiments involving gonadectomy or hormone injections show that in some groups of birds sexual dimorphism may be genetic while in others it is the resultant of pituitary gonadotropins or gonadal hormones or a complex interaction between them (see Danforth in "Sex and Internal Secretions," E. Allen, editor). In orioles the year-round male plumage and total absence of a female plumage in most species suggests that the former is genetic and the latter under hormonal control. While the female plumage could be an expression of gene physiology, the increasing incidence of sexual dimorphism northward in México in races of *Icterus pustulatus* (van Rossem, 1938. *Bull. Brit. Ornith. Club*, 58: 138) strongly suggests environmental control via the pituitary. Moreover, where plumage dimorphism is lacking, females have the plumage of males, not the reverse.

Actually, ornithologists are cautious in using female and juvenal plumage to imply relationship because it is too often absent to serve as a reliable index—and this is especially true in the orioles. I do think the female plumage (plain olive or streaked) in dimorphic species tends to be a throw-back to types, possible primitive, which are still common among Old World insect-eaters. But this conspires to bring out, in bright-hued species of finches, warblers, tanagers, weaver-birds or even starlings (*Aplonis*, *Cinnyricinclus*), female plumages that are similar to those in female orioles or blackbirds (*Agelaius*). And this reversion to a common, inconspicuous type can hardly be considered an index of close relationship comparable with the distinctive plumage patterns of males. Moreover, in oriole species in which both adults have male plumage the juvenals often are protectively colored and it seems logical that the latter may need this protection even when the more experienced female does not. In fact protection appears to be the reason for plumage dimorphism and female plumage is very plastic, changing markedly within the populations of a single species, as van Rossem pointed out. Williams' conclusion that this "female" plumage indicates a yellow ancestry for all orioles is not "inescapable." It is escapable.

Incidentally, Williams also mis-states my case. I do not say that *all* orioles come from a black ancestor. I distinctly say that in my opinion *Icterus* arises from a yellow ancestor (*Xanthopsar*), and I draw a picture of it (Fig. 6).

If Williams' initial assumption concerning the phylogenetic importance of female and juvenal plumage is false, his counterproposals for an arrangement of orioles based on it are likewise false. I am hardly justified in taking space to refute them point by point, since any reader of my paper will know my answers in most cases. Taking his main thesis, we might ask where in Central America is the yellow blackbird from which to derive yellow orioles? Or, if that seems unfair—what is the genetic mechanism by which *Icterus gularis*, *I. pustulatus*, and *I. pectoralis* combine their segregated bill and palate characters in a single, variable descendent species, *I. nigrogularis*, in northern South America? In my paper I contend that these three arise from *nigrogularis*, segregating its variations. It does not work backwards. I am unable to believe in a Central American origin of orioles which then spread into South America. When we try to derive species from species, range by range, the Williams hypothesis breaks down repeatedly. Any ornithologist studying a group will make a number of such schemes for testing, but an hypothesis has no reality—does not exist outside the mind—until it accounts for all of the facts.

I find Williams' proposal somewhat frightening. Space did not permit me to go more deeply into taxonomy and my desire to explore an interesting biological phenomenon (the convergence) tempted conjecture, but I hope my paper will not be regarded by younger ornithologists as a signal for unsupported hypotheses. I consider mine rather well supported.

The complete ignoring, in Williams' superficial hypothesis, of the ecological picture is inexcusable since this picture is known (and given in my paper). In view of the demonstrated plasticity of female plumage I see no justification for putting Cayenne Orioles of dark forest thickets in a different phyletic group from, say, Hooded Orioles of the desert simply because the former lack plumage dimorphism. This is too obviously an environmental effect: one might as well attempt to separate *Agelaius humeralis* of Cuba from all mainland *Agelaius* (from which it is derived) for the same reason. Williams' static morphological arrangement is that of a taxonomist of 100 years ago. It reflects no knowledge of behavior, ecology or geology. Based entirely on color resemblance, it takes no account of evolution under environmental pressures. That type of ornithology is still the best we can do for some parts of the world, but is hardly permissible for the American orioles in the 1950's.

Fr. Haverschmidt's note on *I. nigrogularis* (*Wilson Bulletin*, 63: 45) shows ecological tolerance for the species not previously reported. He finds it confined to swampy areas in Surinam while Todd and Carriker (1922. "The Birds of the Santa Marta Region of Colombia," p. 472) say it is "abundant in the semi-arid coast belt" and quote Simons to the effect that it prefers the cacti and acacias of the hot valleys to the cool forests.

For Bond's opinions (*Wilson Bulletin*, 62: 216) regarding the distribution of West Indian birds I have the greatest respect, but I am unable to see how the absence of *Agelaius* and *Bananivorus* from Jamaica is accounted for by the presence of *Nesopsar nigerrimus* and *Icterus leucopteryx*, even if extinction of the one is implied from the presence of the other. Direct evolution on Jamaica of one oriole from the other is 'out' because they belong to distinct phyletic lines, and this is also true for the blackbirds. That arboreal *Agelaius humeralis* was forced from the Cuban marshes by *A. phoeniceus assimilis* is also incredible because the latter is a very slightly modified recent arrival from the mainland and *A. humeralis* must have required a very long time to achieve its arboreal adaptations.

Since Williams' and Bond's objections both arise partly out of an unwillingness to recognize an additional oriole genus I feel obliged to re-affirm my belief in one. Due to the convergence, my diagnosis must be unconventional—based as it is on the fact that, wherever the two genera are found together, *anywhere in their ranges*, *Bananivorus* is decidedly smaller. But it is also true that the chestnut found in the plumage of the Cayenne Oriole persists in some small degree in all other species of *Bananivorus* except *cucullatus*, *auricapillus* and *parisorum*, the forms most convergent with forms of *Icterus*. But these three make unmistakable, compact *Bananivorus* nests, sewing *through* the leaf. Moreover, the very fact that the orioles of these two genera have distinctly different distributions on the islands of the Caribbean, suggests that they were distributed at different times.

Ornithologists who know its evils have every right to fear the splitting of genera. My own tendency is in the opposite direction but the orioles are numerous in species and the splitting is in the best interest of a classification expressive of phylogeny. A classification that cannot recognize cases of convergence fails to express evolution and is, therefore, one of convenience only. We might as well classify all yellow birds, or all red birds, together. That, too, would be classification of convenience—but it would not be phylogeny.

WILLIAM J. BEECHER

CHICAGO NATURAL HISTORY MUSEUM

ORNITHOLOGICAL LITERATURE

DISTRIBUTION AND ORIGIN OF THE BIRDS OF MEXICO. By Ludlow Griscom. Bulletin of the Museum of Comparative Zoology, Cambridge, Mass., Vol. 103, No. 7, June, 1950: 339–382.

This study by one of the co-authors of "Distributional Check-List of the Birds of México" classifies virtually the whole vast Mexican avifauna, species by species, into seven major groups and 15 sub-groups, each representing a different distributional pattern. Since present-day ranges furnish the chief clues to the area of origin of a given bird, each of these categories further reflects something of the possible recent evolutionary history of the species and genera comprising it. Listed in the order of their importance with the number of species pertaining to each, the seven main groups, corresponding to the seven basic elements in the Mexican avifauna, are: Old North American—432; widely ranging (origins various)—155; South American—147; circumpolar—108; preglacial relict—68; pelagic (origins unknown)—37; West Indian—12. With the further inclusion of stragglers, the estimated grand total reaches about 2200 recognized forms and about 1000 full species, 733 of the latter being resident. These are the first figures of the kind for México to have the backing of a special study, and they probably forecast the approximate number of entries to be included in the completed Check-List. No fewer than 292 species and 69 genera are deemed to be endemic to the Mexican fauna, that is, to political México plus adjoining parts of Central America and of the southwestern United States. But, since the Ruby-throated Hummingbird is included in this category, with full cognizance of the fact that it breeds nowhere in the area outlined, it is apparent that the interpretation of endemism employed is an unusually broad one.

As might be anticipated in an undertaking of this immense scope, dealing with a region that is the scene of much continuing field work, not all of the individual species listings reflect the known facts of distribution with literal accuracy. Particularly evident in this regard are a number of species implied to be absolutely dependent on humid rain forest, though actually they range far beyond that habitat and some of them—as, indeed, has been stated in the Mexican Check-List itself—have developed races that are restricted to arid districts. While such instances are individually misleading, it is unlikely that they have any serious effect on the general conclusions.

The 15 lists, together with the accompanying tables of summary, make up about one-half of the paper. They alternate with passages of commentary designed to explain the evolutionary significance of the various distributional patterns and to stress other pertinent points. The primary emphasis is upon the *loci* of origin of Mexican genera and species. A minimum of direct comparison is afforded, therefore, with Mayr's "History of the North American Bird Fauna" (1946. *Wilson Bulletin*, 58: 3–41), which dealt chiefly with families. Griscom expresses a large measure of agreement with Mayr, though he prefers not to go quite so far in his generalizations. He is tempered in his speculations and wary of the difficulties imposed upon the student of avian origins by the inadequate fossil record, by the extreme mobility of birds, by their adaptability, and by their varying rates of evolution. Because of this and because he has previously expressed his viewpoint in regard to the development of the Central American avifauna, his broader conclusions, though too numerous to summarize here in more than a general way, are, for the most part, lacking in pronounced novelty.

México is pictured as a geologically ancient land, long possessed of a high, mountainous terrain suited to the development of new forms and well supplied off both coasts with islands attractive to sea birds. Always a southern extension of the North American continent, it was never in direct contact with the West Indies, which were to contribute but little to its avifauna. Its first land birds came from the north, and many of them passed on to South America, there to undergo tremendous further evolution into new species, genera, and even families. Later, some of the more aggressive of these newly-developed South American birds spread

back into the Mexican tropics, and the process of interchange was not completely halted even by the various water gaps that separated the two continents during part of the Tertiary. The refrigeration of climate that began in late Pliocene time drove group after group of Old Northern species southward to tropical America. The original South American element in México was almost wholly destroyed, but here and there an occasional species has survived as part of the present list of preglacial relicts. Mountain-dwelling species of the subtropical zone, once isolated by the discontinuity of the higher elevations, descended to the now cool continuity of the lowlands. With the restoration of warm conditions after the Ice Age, these birds reascended into the mountains over a wide range, thus accounting for their present interrupted distribution. On the eastern side of the continent there developed a solid belt of rain forest, extending from central México to South America and providing a highway along which the South American element of Griscom's summary now pushed its way northward. Because of the continuity of this habitat, these birds have developed no new species in México. In the arid Pacific lowlands, on the other hand, rain shadows have produced a sharply contrasting alternation of scrub forest and gallery forest. The resulting ecological islands are so inaccessible to colonization that only one species, a parakeet, has succeeded in establishing a continuous range up the Pacific Coast from Amazonia to Chiapas. But the same factors have worked toward the development of distinctive species of limited range, so that the Pacific lowlands have contributed no fewer than 19 endemics to the great avifauna that makes México such a fascinating field of study for the ornithologist of today.—Robert J. Newman.

BIOLOGICAL INVESTIGATIONS IN MEXICO. By Edward Alphonso Goldman. Smithsonian Miscellaneous Collections, Volume 115, July 13, 1951: xiii + 476 pp., 71 plates, and inserted map. $4.50.

Every person in any way concerned with Mexican ornithology will welcome this work because of its descriptions and photographs of places if for no other reason. The descriptions are arranged alphabetically for each state, and the states, too, are in alphabetical order. The descriptions are, one must remember, of places as they were, not necessarily as they are. The geographical facts about Las Vigas, Veracruz, for example, are certainly correct, though one would never gather from what is said that the slopes about the town, for miles around, are now devoid of trees. The description of Victoria, Tamaulipas, does not even hint at the sisal industry which has so extensively cleared away the thickets, and one would never gather from the comments about Matamoros, Tamaulipas, that tomato fields have so widely replaced the chaparral there. The marshes about Lerma, in the state of México, must have been wonderful in November, 1892, and early July, 1904, when Goldman visited them, but when I first saw them in April, 1939, they were so cluttered up with boats, and what appeared to be dredging machinery that they were a sorry disappointment indeed. The description of the Volcán de Popocatepetl seems to fit today's conditions as well as yesterday's. The visitor to that wonderful mountain is sure to be impressed with the fact that the trees just below the *sacatón* grass area, which extends between snow-line and tree-line, are pines, not firs.

The team of E. W. Nelson and E. A. Goldman worked hard in México. The red lines on the map showing their journeyings from January 25, 1892, to February 20, 1906, appear at first glance to be the political boundaries of the states. They show up more plainly than the dotted black lines (the actual boundaries) and they cover the republic like a net designed to let no part escape. The highly interesting Del Carmen mountain area of northern Coahuila the team did not visit. They did very little work in Sonora. But compare their itinerary with that of many of us who have been working there recently! Most of us are stay-at-homes.

So valuable are the descriptions of places (even though allowance must be made for changes) that one wishes the whole work had been kept more purely historical than it is. The ranges given for the birds listed for the several zones and subzones are not by any means in agreement

with present knowledge, though the names have been brought up to date. Note, for example, that the northern limit for *Ictinia plumbea* and *Spizaëtus ornatus* (p. 322) is given as southern Veracruz. Ornithologists have known, for years now, that these two species breed northward to southern Tamaulipas. *Falco albigularis* (p. 322), stated to range northward to southern Tamaulipas and Nayarit, breeds northward at least to Victoria, Tamaulipas; Linares, Nuevo León; and Guirocoba, Sonora. I have seen *Herpetotheres cachinnans* myself in San Luis Potosí and southern Tamaulipas, and van Rossem has listed it as a breeding bird of Sonora, yet in this work (p. 322) southern Veracruz is given as its northern limit. Most of the range-summaries are at least largely correct, but cursory inspection indicates that about half of them are not by any means up to date. Had these summaries been corrected along with the birds' names this work would be indispensable to present day workers. As it stands it is likely to be badly misleading because it is neither patently historical nor actually definitive. This adverse criticism must not be construed as a belittling of the work of Nelson and Goldman. Their work was nothing short of splendid. But where money is poured into publishing a great work of this sort and an attempt is made to bring the whole opus up to date *in some ways*, enough time and money should be put into it to make it a dependable reference work.

As for the several lists of birds believed to be representative of certain zones and subzones, opinion will differ according to the reader's own field experience. *Momotus momota coeruliceps*, listed on p. 115 as a bird of the Humid Upper Tropical Subzone, is stated to be also a bird of the Arid Upper Tropical Subzone. Why not also of the Humid Lower Tropical Subzone? It breeds, and commonly, in southern Tamaulipas in areas inhabited by *Cairina moschata*, *Cochlearius cochlearius*, *Ictinia plumbea*, and many other species listed as birds of this very subzone. This criticism, which might be levelled against the inclusion of many species in certain of the lists, must not be taken as haggling. What I am saying is that, the lists being what they are—namely, a summary of the knowledge of some years ago—they must not be regarded as authoritative for the present.

Proof reading, unfortunately, was careless, and this fault is the more deplorable because a work of this sort is certain to be regarded as authoritative. The name of the Mexican Crow is *Corvus imparatus*, not *imperatus*. The name of the beautiful mountain is Ixtacihuatl or Ixtaccihuatl. Pronounced as (incorrectly) spelled in the legends for Plates 68 and 69, it would be strange and unmelodious.—George Miksch Sutton.

SPECIES FORMATION IN THE RED-EYED TOWHEES OF MEXICO. By Charles G. Sibley. University of California Publications in Zoology, Vol. 50, University of California Press, Berkeley and Los Angeles, 1950: 6¾ × 10¼ in., pp. 109–194, plates 11–16, 18 figs. in text. $1.50.

This study of geographic variation in Mexican towhees adds another to the rapidly mounting list of thorough investigations of species formation. Sibley has seen that the problems arising in such studies cannot be adequately investigated in the museum alone, and he has integrated field observation very nicely with his statistical analysis of variation in color and mensural characters of skins. He has also recognized the fact that the characters of the present populations have resulted from the interaction of earlier genotypes with the changing environments.

Presentation of data follows a set pattern for each of the fifteen forms (two species, the first with ten subspecies, the second with five subspecies) considered and for the most part this pattern is a usable one. Mean measurements with their standard errors, standard deviations, and coefficients of variation are given for all but one of the races treated. It does seem unfortunate that the column set aside for the tabulation of "coefficient of variation," which is not used in the critical discussion, could not have been used to show the limits of the mean plus or minus one standard deviation. The necessity of continued turning of pages back and forth while mentally adding and subtracting is a common failing of practically all papers of this type. The reader desiring the information about variability is provided with the data, in

the form of the means and their standard deviations, whereby this statistic can easily be calculated. It would have been helpful if the author had presented more information on statistical methods of analysis utilized. Some of the samples were very small (3–6) and perhaps worthy of special treatment. The terms *significant* and *significantly* are loosely used in a number of places. Thus, on p. 135, in discussing the Mount Orizaba Red-eyed Towhee population, Sibley says: ". . . although in some measurements . . . and in color tones they are significantly different from topotypical *P. e. maculatus*," he does not, so far as this reviewer can determine, present data showing that the color differences referred to *are* significant. Again, on p. 173, we encounter twice the phrase "significant barrier" without being told what a significant barrier is. Loose use of important words of this sort may leave a reader in doubt and confusion.

It would be helpful to know what criterion of separability was utilized in arriving at opinions regarding the validity of the subspecies recognized. Much has been written in recent times regarding this question and it is unfortunate that the author has not given direct information concerning the degree of separability which obtains amongst the various races considered.

For the reader not thoroughly familiar with place names and localities the Hubbs-Perlmutter diagrams are difficult to use. The author apparently feels that all of the subspecies recognized are identifiable on the basis of color, and utilizes these charts of mensural characters simply to show trends and interactions among the populations treated. It would be of interest to know the number of specimens involved in the preparation of these data.

The defects pointed out are all minor ones and do not at all detract from the soundness of analysis. Sibley's comments on the interspecific contacts between *P. ocai brunnescens* and *P. erythrophthalmus oaxacae* and the resultant hybridization and intergradation are especially interesting. It is particularly pleasurable to note his recommendation that *Pipilo maculatus* and *P. macronyx* be considered conspecific with *P. erythrophthalmus*. This action has long been indicated.

The plates showing typical habitats are of interest to readers familiar with *P. erythrophthalmus* in the eastern United States. With the exception of altitude, the subspecies found in eastern Canada and the eastern United States apparently show much the same habitat preferences as do the Mexican races.

This publication should be of great value to all serious students of zoogeography.—J. C. Dickinson, Jr.

GRØNLANDS FUGLE. THE BIRDS OF GREENLAND. Part 2. By Finn Salomonsen. Ejnar Munksgaard, Copenhagen, 1951: 9 × 13 in., pp. 159–348, 19 color-plates and numerous decorative sketches by Gitz-Johansen. Paper. Appearing in three parts, each at $9.00, but parts cannot be supplied separately.

For at least three reasons is this sumptuous work also great. First, it focuses sharply on Greenland, yet the reader is never permitted to forget that that island is only a part of the vast arctic whole. Second, it has balance: the taxonomic discussions are cogent and informative, but not over-long; the parts dealing with life history are readable without being discursive; the distributional material, though detailed, does not dominate. Third, and best of all, the work keeps beautifully in key: color-plates, black and white sketches, native names of birds, place-names, even the idiom—all reflect and call to mind Greenland. Part 2, like Part 1, is full of data based on recovery of ringed birds (the Danish government has sponsored this work for a long time); on specimens, most of them now in Copenhagen, collected on numerous expeditions; and on long hours of personal observation and work in the field.

Part 2 deals with the Rock Ptarmigan (*Lagopus mutus*) and with six charadriids, nine scolopacids, two phalaropes, three skuas, nine gulls, and one tern. Six of these 31 forms are only briefly discussed. Among the 25 fully written up are three not known to breed in Green-

land—the European Golden Plover (*Pluvialis apricaria*), American Golden Plover (*P. dominica*), and Whimbrel (*Numenius phaeopus*). There are many records for all three of these species and the author's explanation of their occurrence is well presented. Some readers will be surprised to note that the well known Semipalmated Sandpiper (*Ereunetes pusillus*) and Least Sandpiper (*Erolia minutilla*) are nowhere mentioned. Another species 'conspicuous by its absence' is the Great Skua (*Catharacta skua*), a bird of very limited breeding distribution in the north.

Part 2 makes at least two contributions to popular knowledge. One of these has to do with the world's northernmost bird. Pleske, in his "Birds of the Eurasian Tundra," stated (p. 346) that 85° 5′ north latitude, at which degree the *Fram* had encountered the Fulmar (*Fulmarus glacialis*), was the "most northerly point attained by any bird." Alexander, in his "Birds of the Ocean," called the Ivory Gull (*Pagophila eburnea*) "the most northerly of all birds" (p. 136). Salomonsen, in "The Birds of Greenland," says of the Ivory Gull: "It lives nearest to the Pole of all birds and has been observed northwards almost to 85° n. lat." (p. 286). The Rock Ptarmigan collected by Feilden in 1876 in Grant Land was, Salomonsen assures us, the northernmost ptarmigan ever collected by man, but the northernmost *bird* ever collected was a Turnstone (*Arenaria interpres*). The latter specimen, now in Copenhagen, was taken at Low Point, on the north coast of Peary Land, at 83° 7′ n. lat. (p. 205).

Another matter of general interest is the crossing of the notorious ice-cap by birds. Salomonsen states (p. 284) that the Long-tailed Skua (*Stercorarius longicaudus*) is "the only bird which makes long excursions over the ice-cap, covering hundreds of km and sometimes approaching the center of Greenland." By the sheerest of coincidence, I recently received from William H. Allen, a friend since the days when we were army officers together, a photograph of this

A Long-tailed Skua or Jaeger (*Stercorarius longicaudus*) about one hundred miles in from the edge of the Greenland ice-cap. Note the vague barring on the under wing coverts—evidence of immaturity. The picture was sent to the editor by his friend William H. Allen, of the staff of Air University Library, Maxwell Air Force Base, Alabama.

beautiful species taken about a hundred miles in from the edge of the ice-cap. The exact spot at which the bird was encountered cannot, for reasons of security, be stated, but the picture is intensely interesting none the less, especially in the light of Salomonsen's statement.

Certain of Salomonsen's distributional data are thought-provoking to say the least. There are puzzling gaps in the breeding range of the Arctic Tern (*Sterna paradisaea*). The American Golden Plover (31 records, all based on skins) has been reported only from the west coast, principally in the Disko Bay area. The Long-tailed Skua, which breeds commonly in the north, is "very rarely observed in southern Greenland," for its migrations are largely pelagic (p. 283). The Iceland Gull (*Larus glaucoides*) is, aside from the Kittiwake (*Rissa tridactyla*), the commonest gull of West Greenland, but in its breeding "it is restricted to the fjord-country in the interior" (p. 313). These are but samples. Data presented clearly show that amelioration of climate has led to remarkable range-change; that competition for food and nest-sites has brought about otherwise inexplicable situations; that some arch-competitors, notably the Great Blackback (*Larus marinus*) and Glaucous Gull (*L. hyperboreus*), manage to 'stand each other' remarkably well where their ranges overlap.

The color-plates, despite their shocking crudity, are strikingly *in character*. As reproductions of brisk water-colors they are fairly breath-taking. Speaking as a fellow bird artist, however, I wish that Gitz-Johansen would refrain from outlining a white breast in black. I wish he would study more closely (not, I hasten to make clear, draw in greater detail, but *study*) the perspective of spread wings. I wish he would never forget what happens to a flying bird when its wings fail to keep it in one place (as when hovering) or to hold it up and push it forward (as in ordinary flight). One of the most beautiful spots in the book is the back of the Iceland Gull (plate 32). Here the effect of softness and cleanness is incredibly authentic and beautiful.—George Miksch Sutton.

THE BIRDS OF NEWFOUNDLAND. By Harold S. Peters and Thomas D. Burleigh. Department of Natural Resources, Province of Newfoundland, St. John's, 1951: 6½ × 9 in., xix + 431 pp., 32 color-plates, 40 text figures and pictorial map end-papers by Roger Tory Peterson. $6.00.

Rugged Newfoundland has long been one of the most backward political entities on this continent in wildlife conservation matters. Not until 1949 when it became Canada's newest province did it become a party to the International Migratory Bird Treaty of 1916. As Britain's oldest colony it maintained its aloof individuality and made its own game laws, lax compared to those of its neighbors. Its fisherman population has always utilized its once abundant bird-life as a source of food, a welcome change from an otherwise monotonous diet of "fish and brewis." There loons, alcids, and gulls are hunted and eaten as avidly as geese and ptarmigans; egging the sea-bird colonies has always been established practice. Enforcement of the mildest game laws is difficult, and not pressed actively by the politically wise.

It is praiseworthy indeed, and a great step forward for the Newfoundland government to sponsor and finance a book "to aid the people of Newfoundland in identifying the birds of that Island and to provide information concerning these birds," as the authors say in their preface. With this in mind Messrs. Peters and Burleigh have provided a fairly adequate volume for the needs of the people of the area. Their brief descriptions and field marks, when used in combination with the 32 competent colored plates by Roger Tory Peterson, are sufficient to enable any reader to identify the local birds. Short accounts of voice, nest and eggs, range, and habits, largely abridged from standard reference works, supply the essential information available for each form recognized.

Between 1937 and 1947 the authors covered their territory thoroughly, spending a total of 304 days in field work which should have made them more familiar with the flavor and color of this distinctive island than is apparent from their text. They have reviewed the literature

and examined much of the specimen material available in North American museums. It is also gratifying to note their extensive use of banding data, a source of information still too little used. They have followed the as yet unpublished dictates of the AOU committee for their scientific and accepted English names, a preview which reveals many of the latter to be rather unwieldy mouthfuls for lay use.

The analysis of data on occurrence is becoming a difficult and delicate matter in this day of increasing use of sight records. The serious student may question the authors' evaluation of their evidence of the local status of each species and subspecies. More than 25% of the forms recognized are considered "casual" or "accidental" which, though the categories are not defined, seems abnormally high for an area so little worked ornithologically. They seem to have been neither sufficiently critical of their material nor consistent in their treatment of it. Why, for instance, do they accept, apparently on the basis of sight records alone, the Ruby-throated Hummingbird and Nighthawk which are at best rare, irregular visitants of uncertain status, and reject for lack of specimen evidence Barrow's Golden-eye which is certainly of regular occurrence, and for which they present equally valid sight records? They wisely relegate to the hypothetical list 55 other species for which no specimen evidence exists, but accept such rarities as the Yellow-nosed Albatross and Sandhill Crane, among others, on the basis of old mounted specimens formerly in the St. John's Museum, since destroyed by fire, which were completely without data, and which may well have arrived there as curios brought home by Newfoundland's far-travelling seafarers.

The volume is handsomely produced and well printed. Peterson's 40 black and white text figures and his picto-map end-papers are very fine. It is a pity the manuscript was not competently edited to correct grammatical errors and awkward use of English because it is the only work available on the birds of this unique island and will doubtless have a wide distribution both at home and abroad. It is to be hoped it will stimulate and encourage the Newfoundlanders to appreciate and conserve their avifauna, and perhaps to study it and give a more accurate and comprehensive knowledge of it to the world.—O. L. Austin, Jr.

THE HAWAIIAN HONEYCREEPERS (AVES, DREPANIIDAE). By Dean Amadon. Bulletin of the American Museum of Natural History, Volume 95, article 4, December 11, 1950: pp. 151–262, figs. 1–23, pls. 9–15, tables 1–15. $1.75.

Perhaps nowhere else in the world was there such remarkable opportunity for a thorough comparative study of the mechanisms of adaptive radiation as that offered by the Hawaiian honeycreepers. On these volcanic islands all conditions were ideal: varying degrees of isolation, diversity of available niches, repeated cataclysmic changes, relative freedom from natural enemies, and plastic immigrant stock upon which evolution could work. The divergence of the drepaniids has been correspondingly extreme. The great pity is that the broader concepts of biological thinking had not developed to the point where such a study could have been undertaken fifty or seventy-five years ago. Like the author, I spent a considerable part of my army service in Hawaii; I was able to get a very little field experience with the Drepaniidae, or with the pitiful remnants thereof. I know their unique fascination. But I also can appreciate firsthand the near-hopelessness of trying to reconstruct conditions in the primeval forests, which were already on the wane in the days of Perkins and Henshaw (around the turn of the century); or of making comparative studies when a large percentage of the forms are extinct, or so nearly so that work on them is impracticable, and existing material is grossly inadequate.

We are not told precisely what material was used in all parts of the study, or how many specimens were handled in all. But it is clear that much time was spent in the Bishop Museum in Honolulu, and that the large series in the American Museum of Natural History (especially in the Rothschild collection), formed the "principal basis." Apparently far more specimens were examined, particularly of *Vestiaria*, in the study of plumages than in other connections.

In the systematic list, which includes diagnoses and distributions, the 22 species and total of 39 forms are grouped into two subfamilies and only nine genera: a far less cumbersome arrangement than those heretofore employed (e.g., in Munro's "Birds of Hawaii." 1944. pp. 89 ff., where 17 genera are used, following Perkins). No particular evidence is presented as a basis for the consolidation; but it seems justified in view of the "great morphological diversity existing among closely related species in this family," and certainly makes for easier understanding of the groups.

The analysis of measurements is given considerable space, although many conclusions here are either very general or negative. There is interesting discussion of racial and specific variations, limiting of variability by small population-size (not demonstrated), possible effects of allometric growth in some forms, and probable adaptive significance of characters. The ratio diagrams (based on a method of Simpson's and explained in an appendix) show quite strikingly the changes in body proportions; I wish it had been possible to extend their use to include both higher and lower categories in more detail.

The anatomical section, while very instructive, nevertheless suffers most of all from the woeful lack of comparative material. Repeatedly we are led into some new aspect or other, only to find that data are insufficient or conflicting, and that we can after all conclude little or nothing. The emphasis here is upon probable relationships of the family, and scarcely at all (as the author points out) upon patterns of radiation within it. While Amadon favors an origin from some generalized coerebid, he does not close the door to other possibilities. We are left with the idea that the nine-primaried passerines are such a close-knit group that, since the ancestral drepaniid was an insect- or nectar-feeding member of this basic stock, it makes little difference just what we call it. While we evidently postulate a monophyletic origin for the family, I find no definite evidence brought to bear upon this point. However, the data in the various sections of the study are made to support very strongly a divergence into the two subfamilial lines—evolution in the one case largely through extreme modification in bill, and in the other through less marked structural change coupled with change in coloration.

There are many pages of general discussion, dealing with various aspects of speciation phenomena, with examples drawn both from the Drepaniidae and from other groups. The endemicity of the Drepaniidae and of other Hawaiian birds is summarized in tables and maps. Stress is given the importance of isolation, secondary overlap, and competition between adaptive types in radiation of species and of higher categories. Several instances are pointed out and explained. This discussion, in addition to being informative, is keenly thought-provoking. It is fascinating to consider, for example, *why* the two species still most abundant are not only among the most widespread (one breaking up into subspecies and the other not), but also allegedly the most primitive of their respective subfamilies. And why should the Drepaniinae, in which all the genera but one are monotypic, and of which the two most primitive members are such frequent inter-island stragglers as to inhibit even subspeciation, yet have evolved more genera than the Psittirostrinae, with three of its four genera rather highly polytypic.

There is an occasional apparent contradiction in the text; the present status of *Drepanis* (while given elsewhere) is omitted from the species-by-species summary of this information; I noted three minor typographical errors; one might wonder why the tree *Metrosideros* has one specific name in the text and another under the figure.

The paper and print are good, and the seven plates of remarkably sharp and clear photographs of skins serve well as illustrations. The conclusions are for the most part conservative, and the data well presented. Viewed in the light of present-day conditions, the paper appears splendidly worked out; it gathers available data from many sources, and presents us with as clear a picture of the structure, plumage, habits, general ecology, and relationships of this family as is now available. Most criticisms that might be made are more a reflection of the difficulties involved than a discredit to Amadon's capable work.—William A. Lunk.

A Guide to Bird Finding East of the Mississippi. By Olin Sewall Pettingill, Jr. Oxford University Press, New York, 1951: 4½ × 7¼ in., xxi + 659 pp., 72 pen-and-ink sketches by George Miksch Sutton. $5.

Now for the first time we have a Baedeker for bird watchers.

Anyone who has travelled into unfamiliar territory with limited time hoping to see the distinctive birds of the area—and who hasn't?—will appreciate the usefulness of such a book. In fact, out of just such experiences of his own, usually disappointing, came Pettingill's inspiration for this guide.

The amount of information contained here is astonishing. There are descriptions of more than 500 places of ornithological interest, with detailed suggestions for reaching them, for finding lodgings, for securing permission to enter, and for solving other problems confronting the visitor. Most of these are places for seeing birds in the wild—in nesting season, during migration, or on the wintering grounds. But there are notations also on zoos, museums, libraries, research stations, bird clubs and other institutions of ornithological importance. A chapter is devoted to each of the 26 eastern states with two exceptions (two states combined), and the points of interest appear alphabetically according to the name of the nearest town shown on road maps.

A feature of special merit is the ecological description of the state at the beginning of each chapter. This feature will command the attention not only of ornithologists but also of naturalists generally. Although most of the book is intended for reference rather than for consecutive reading, many people will find themselves skipping through the chapters, reading the state descriptions with interest. There are few people indeed who will not be surprised to learn what a diversity of habitat occurs in every state, even a prairie state like Illinois.

No one person alone could have written this book, as Pettingill acknowledges. The finished product is a triumph of cooperative effort. Probably there has never before been a book in ornithology that has had so many people participating directly in the preparation (more than 300). Yet Pettingill's terse style marks the whole, including four chapters written by state authorities.

The sketches of birds have the lifelike quality of form and motion we have come to expect from the skilled hand of George Miksch Sutton.

At the end of the state chapters there is a list of books for further reference—guides to field identification and regional publications.

The alphabetical index to places and bird species appears quite complete, but I consider it a little unfortunate that some attractions are not to be found directly under their well-known names. For example, I did not discover immediately that Hawk Mountain was listed under "mountains," nor that Pymatuning was listed under "swamps" and placed in the Pennsylvania chapter. (It is also a lake lying mostly in Ohio.) Still, this is a minor point and it does not detract appreciably, if at all, from the fine work. The searcher for a specific item will applaud the practice of showing place names in capital letters throughout the book so that a familiar name may be found fairly easily by scanning the proper chapter.—Harold Mayfield.

Audubon Water Bird Guide. By Richard H. Pough. Doubleday & Company, Inc., Garden City, New York, 1951: 4½ × 7¼ in., xxviii + 352 pp., 48 colored plates and 138 black and white drawings. $3.50.

This volume complements Dr. Pough's earlier *Eastern Land Birds* in the Audubon Bird Guide series. Its scope is defined by the sub-title, "Water, game, and large land birds of Eastern and Central North America from Southern Texas to Central Greenland, most of which range to the Pacific Coast." There are 485 illustrations in color on 48 plates by Don Eckelberry, and 138 in black and white by Earl L. Poole.

Those of us who grew up with the handy little Reed "Guides" in our hip pockets will recognize Pough's spiritual inheritance from these useful, but decidedly limited, volumes. Division of species and territory covered by both authors are approximately the same, but Pough's works are enriched by a wealth of material which precludes their fitting into anyone's hip pocket. Modern bird students will, however, gladly sacrifice the convenience of Reed's books for the excellent text and fine illustrations in the present volumes.

The *Audubon Water Bird Guide* treats each species under the sub-heads *identification*, *habits*, *voice*, *nest*, and *range*. Measurements include overall length, length of wing, and, for some species, length of bill. A valuable feature is the average weight given for most species. For ready comparison there are numerous tables showing average length and wingspread of related species, or of birds likely to be observed in the same habitat. Vernacular names follow newer concepts in nomenclature. Where there is disagreement between American names and those recognized by the British Ornithologists' Union, the latter are given in parentheses. Data are given on bird ages where these are known.

As might be expected from Dr. Pough's background and interests, there is much emphasis on sound ecology and militant conservation in the treatment of each species. Birds are related to their habitats through a discussion of food and cover requirements. Attention is called to the fertilizing effect of large bird colonies, and the influence of this factor on fish, shellfish, and other aquatic populations. Possibilities of extending the ranges of species with limited distributions are explored.

From the inclusion of detailed information on ranges, the reader will derive an impression of the holarctic character of our waterfowl and of many of our larger land birds. The front end-piece is a map of the North Atlantic, with named quadrats and information on water temperatures and major flight-routes. Inside the back cover is a map of North America showing major biotic regions. Extralimital species which occur in eastern North America as casuals or strays are rather fully treated.

Eckelberry's colored illustrations are arranged on plates bound in the center of the volume. They show major plumage phases, and are generally excellently drawn and well reproduced. Plate No. 48 includes the pigeons and doves, and encounters the difficulty of reproducing exactly the delicate iridescent shades in the plumages of these birds. Poole's black and white drawings accompany the text.

The author's foreword contains pertinent suggestions for the best use of the volume. A well arranged Table of Contents shows families and genera, and makes reference to text and illustrations easy. Information is concise and well presented. Because of the ecology and conservation which is included, this volume is much more than a "bird guide".—Maurice Brooks.

ONTARIO BIRDS. By L. L. Snyder. Clarke, Irwin & Company, Ltd., Toronto, 1951: 6 × 9¼ in., x + 248 pp., with 146 line drawings by T. M. Shortt. $4.50.

We have in this attractive volume a source of general information on the common birds of Ontario, authored by one of Canada's leading ornithologists who, since 1935, has served as Curator of Ornithology at the Royal Ontario Museum of Zoology in Toronto. As stated in the Preface, the book is in no sense a complete reference work nor a guide to field identification; rather is it "intended as a source book for teachers, pupils, amateur naturalists, and all out-of-doors people, for use indoors."

The first four chapters are of an introductory nature, pointing out, respectively, the characteristics of the bird as an animal; certain peculiarities of bird distribution; a few outstanding facts obtained from observations of bird migration; and the accepted method of classifying birds, together with a list of the 351 Ontario species grouped according to orders and families. The fifth and last chapter, entitled "Natural History," comprises the bulk of the book (pp. 33–235) and contains its principal substance. A Spring Calendar giving the first-arrival dates

of 50 common migrant birds; an adequate index; and endpaper maps showing all the Ontario places mentioned in the text, complete the volume.

Under "Natural History" the common Ontario bird species are taken up by families in phylogenetic order. There are subheadings for families, but not for species. After each family subheading the text usually consists of, first, a description of the more obvious family characteristics and, second, a discussion of each of the common species with respect to its geographical and seasonal distribution in the province, habitat, song (if any), nesting habits, feeding habits, and general winter range. Aside from the parenthetical use of the scientific names of families and species, and of an occasional term denoting an anatomical feature, all technical terminology is avoided. The information presented is consistently pertinent, clearly demonstrating that the author, with his years of experience in a public institution, understands what people, when inquiring about birds, want to know. The style of writing is simple and direct, without flowery expressions, dramatized anecdotes, whimsical comments, anthropomorphisms, or other devices often considered necessary to satisfying public interest. For a presentation that reads easily and informs well, it is, in the opinion of this reviewer, one of the finest examples extant.

Scattered through the volume are 146 line drawings by T. M. Shortt, Chief of the Division of Art and Exhibits at the Royal Ontario Museum of Zoology. Forty-nine are of the bird skeleton and external structural characters distinguishing bird families; the remainder are of live birds in various attitudes. All are beautifully done and contribute immeasurably to the attractiveness of the work. Some of the drawings of live birds are especially refreshing.

Only one unfavorable criticism of "Ontario Birds" seems justified, namely, its failure to include any reference whatever to other sources of information. Arousing, as it inevitably will, an interest in birds, the book should present somewhere a list of guides to identification, sound recordings, treatises on methods of attracting and studying birds, and some of the more readable works on such important ornithological matters as migration, distribution, and life history. Readers would then be encouraged to widen their interest.—Olin Sewall Pettingill, Jr.

BIRDS' NESTS OF THE WEST. A FIELD GUIDE. By Richard Headstrom. Ives Washburn, Inc., New York, 1951: 4¼ × 7¼ in., 177 pp., with 29 photographs. $3.00.

Bird-watchers living in the western part of the United States will be pleased to learn of Mr. Headstrom's latest book. This volume contains keys for nest identification of birds breeding in the United States west of the one hundredth meridian. The keys are arranged according to the general habitat and location of the nest-sites. The 29 generally excellent photographs of nests taken by Harry L. and Ruth Crockett add considerably to the value of the book. More thought might have been given to the selection of species to be illustrated, however. For example, 4 of the 29 photographs are devoted to the dove family, while the warblers are not represented at all. The eggs of few species have been illustrated as many times as those of the Killdeer. Their inclusion here was hardly necessary.

In his "Birds' Nests" of the eastern United States (1949: 24), Mr. Headstrom stated: "This guide is an attempt to help those who enjoy nest-hunting to identify nests with some measure of success, especially during the winter months in the North, when many nests are easy to see. And since bird life and plant life are then at their lowest ebb for observation, another objective will add interest to our winter trips." Mr. Headstrom has done an admirable job in fulfilling the purpose for which his two field guides were written. Scout leaders, teachers, and nature counselors should find these guides indispensable in their work with children.

In the introduction (p. 18) of the present volume, Mr. Headstrom says: "It must be admitted that the best way of identifying a nest is when it is still occupied by the maker." The books were not written for, nor will they be of much value to, the professional ornithologist or serious amateur bird student.—Andrew J. Berger.

ADAPTATIONS OF ANIMALS TO CLIMATIC EXTREMES: A REVIEW

BY A. D. MOORE

BODY INSULATION OF SOME ARCTIC AND TROPICAL MAMMALS AND BIRDS. By P. F. Scholander, Vladimir Walters, Raymond Hock, and Laurence Irving. *Biological Bulletin*, Vol. 99, No. 2, pp. 225–236, October, 1950.

HEAT REGULATION IN SOME ARCTIC AND TROPICAL MAMMALS AND BIRDS. By P. F. Scholander, Raymond Hock, Vladimir Walters, Fred Johnson, and Laurence Irving. *Biological Bulletin*, Vol. 99, No. 2, pp. 237–258, October, 1950.

ADAPTATION TO COLD IN ARCTIC AND TROPICAL MAMMALS AND BIRDS IN RELATION TO BODY TEMPERATURE, INSULATION, AND BASAL METABOLIC RATE. By P. F. Scholander, Raymond Hock, Vladimir Walters, and Laurence Irving. *Biological Bulletin*, Vol. 99, No. 2, 259–271, October, 1950.

These three papers are important additions to the literature on body insulation, basal metabolism, heat regulation, and cold adaptation of arctic and tropical mammals and birds.

The biological literature has long been crowded with qualitative discussions of the role of fur, feathers, and fat in heat conservation. However, very few measurements have been made. Here, at last (in the first paper), Scholander, *et al.* report on the thickness of fur and fat on the mammals they studied; they actually made measurements from which the thermal conductivities could be found. The arctic work was done on winter furs of mammals at Point Barrow, Alaska. The studies were rounded out by working with tropical animals in Panamá.

Pieces of fur, taken from more thickly furred areas, were stretched tight against both sides of a round, flat hot-plate and its surrounding guard ring. The plate and ring were kept at 37° C. The fur was roughed up to give maximum insulating effect. The surrounding box, with its still air, was kept at 0°; additionally, for the beaver, polar bear and seal, there was immersion of the hide in ice water. The inner side of the skin was moistened; but as the authors point out, the temperature drop measured through the skin seems high, and is no doubt due to poor contact between skin and hot-plate. This writer would suggest that perfect contact as well as moistening might be attained by coating the skin's inner side with rather viscous Methocel solution. Methocel, a Dow Chemical Company product, is virtually inert; it can be mixed with water to almost any degree of viscosity desired.

When thus measured flatwise, it was found that the quality of the prime arctic furs and the better tropical furs was roughly constant. That is, for parallel heat flow out through a flat-stretched piece of fur, for a given temperature drop through the fur, the rate of heat flow per unit of area was inversely proportional to the fur thickness: double the thickness, and the rate of flow is halved. The charts showing what the authors call "insulation," plotted against fur thickness and against animal weight, give values as measured by the above flat method, for skin plus fur (or blubber plus skin for the seal); and is given in terms of 1/(Cals. m^2/24 hrs./1° C.). This will take on meaning if restated: it is the degrees C. drop through the skin and fur, for a rate of heat flow of one kg.-calorie per day, for an area of one square meter.

This matter of "insulation" value and its meaning is of critical importance. Several meanings of "insulation" are possible, if factors are taken only one at a time. To make this clear, consider two animals, precisely similar in every way, having a size ratio (e.g., height ratio) of 1:2. The fur thicknesses are 1:2; the surface areas are 1:4; the fur volumes are 1:8. If clipped and weighed, the two batches of fur would have a weight ratio of 1:8. Thus, if we were in business, selling such insulation, the insulation values would be 1:8; but this is a useless heat conservation criterion for the animals themselves. Starting over again, we note that the sur-

face area ratio is 1:4, and we might conclude that the insulation values are the inverse of this, or 4:1; but again, this factor alone will not tell us about the relative heat losses of the two animals. Trying another factor alone, we point to the fur thickness, and its ratio of 1:2, and might conclude that the larger animal is twice as well insulated as the smaller. This conclusion is also untenable: the factor of fur thickness alone is not sufficient. However, this last seems to be the viewpoint presented and used in the first paper. Such a concept of "insulation" may obscure some important issues. A different analysis will now be given.

Both the area and the fur thickness should be taken into account. For the above similar animals, the fur thicknesses are 1:2, tending to reduce the larger animal's loss; but the surface areas are 1:4, tending still more to increase it. Combining the two factors, we find that for the same temperature drop, the heat loss rates would be 1:2. The larger would dissipate twice as much as the smaller.

But, if the smaller animal is taken to be adequately insulated, the larger would turn out to be over-insulated. Their weight ratio is 1:8. Using the correlation of basal metabolic rate, calories per day versus weight, as adopted by Benedict or as given in the third paper, the larger animal's basal heat production rate is about five times that of the smaller. The heat production ratio is 1:5. Thus, if the larger animal were given twice the smaller one's fur thickness as assumed so far, it could dissipate at only twice the smaller one's rate through the coat, but would have five times as much heat to get rid of. Therefore, it should have considerably *less* than twice as much fur thickness.

In fact, it can be argued that the larger animal's fur thickness should be less than that of the smaller! If we adopt the *same* thickness for both, the larger has five times the heat to lose, but only four times the area to lose it from. Therefore, if the smaller animal is adequately insulated, the fur of the larger is more than adequate at the same thickness. However, the writer can see at least three considerations stepping in to prevent the adoption of less and less fur thickness as size becomes greater and greater.

First, the larger land mammals must survive while abroad or resting, under extreme exposures. The taller they are, the greater are the wind velocities at their body levels. This is a factor of real importance, but the biological literature has neglected it. Standing in the "same" wind, a moose is exposed to much higher velocities than is the marten or weasel.

Second, when an animal is lying down on cold snow—with fur compressed and the insulating value of the fur reduced—the pressure per unit of area on the fur doubles when the size is doubled. The compressing effect for a lemming-size animal is very low indeed; for a caribou it is vastly greater. Highly compressed fur is a poor insulator, due both to its reduced thickness and to its being compacted.

Third, animals are not flat, like signboards, with flat slabs of insulation stretched on them. They are made up of roughly cylindrical parts. Heat flow out through the fur is more or less divergent, or radial, in character. A 10 mm. thickness of fur on a very small animal has far from the same heat-conserving value, per unit of surface area, as the same thickness of fur on a large animal. The fact that the geometry of the case plays a major part in considering small versus large has not been adequately recognized in this kind of literature.

Turning to the animals, compare the lemming and the Eskimo dog, the weight ratio being about 1:1000, the size ratio therefore about 1:10. The lemming fur thickness is about 20 mm. If fur thickness had to obey the law of similarity, the dog would have an unwieldy 200 mm. of fur thickness. Or if we use only the factors of relative heat production and relative area, the dog should have less than 20 mm. But with the three considerations in mind, it is not surprising to find that the dog actually has about 40 mm., or about twice that of the lemming. Moreover, the dog can sleep outdoors through the arctic weather, and the lemming cannot. Also with the foregoing arguments in mind, we are not surprised to learn from the paper that when the size of the fox or dog is reached, increase of size occasions little change in fur thickness.

"From the size of a fox to the size of a moose there is no correlation between insulation and

body size, they all have about the same insulation per surface area" is one of the conclusions. This must first be corrected to read, per *unit* of surface area. They then do have "about the same insulation," when measured flatwise as described in the paper. But when the geometry of flow (the radial flow effect) in the fur, as actually worn, is taken into account, the insulating effect for the smaller of these animals is less than it at first seems to be.

The data secured are valuable. Eventually, when geometry of heat flow, habits of the animals in evading or accepting extreme exposure, wind effect related to size, and compression of fur when resting or sleeping—when these various considerations can be evaluated and weighted into the analysis, we may eventually be able to work out a very good correlation of fur-thickness with size.

An attempt was made to secure insulation measurements for snow bunting and ptarmigan skins. "However, these measurements are less satisfactory since it is impossible to produce on the test plate the well-ordered elevation of the feathers which the live bird can achieve to produce maximum insulation." That is, flatwise testing of small skins does not work out well. This points to the need for developing test methods in which skins will have more nearly their natural conformation, by stretching them over cylinders or spheres, or even models of the animals themselves.

The paper has some good discussion of animal heat loss as affected by vasomotor control, and of the way the legs and feet of arctic animals are adapted to tolerate extreme cold exposure and at the same time reduce heat loss, by permitting these members to go to low temperatures.

The second paper gives valuable new data on basal metabolic rates and heat regulation for arctic and tropical mammals and birds. The mammals studied at Point Barrow were the white fox, Eskimo dog, polar bear (cub), ground squirrel, lemming and weasel; the birds, the Glaucous Gull (*Larus hyperboreus*), Canada Jay (*Perisoreus canadensis*) and Snow Bunting (*Plectrophenax nivalis*). The Panamá mammals were the two-toed sloth, night monkey, marmoset, raccoon, coati and jungle rat; the birds, the Yellow-thighed Manakin (*Pipra mentalis*) and Pauraque (*Nyctidromus albicollis*).

Measurements of metabolic rates were made in a controlled-temperature respiration chamber, the heat production being determined by the oxygen consumption or carbon dioxide production. Each animal was started in its thermoneutral zone. Within this zone of lowest metabolic rate (conditions being that the animal is awake, resting, and in the post-absorptive state) lowering the chamber air temperature does not change the rate of heat production or heat loss. Instead, the animal compensates for the increased cold exposure by pilomotor erection of fur or feathers, which increases the insulating value of the coat; by vasomotor control of heat carried by the blood to skin and limbs; by vasomotor control of temperature of these parts; by changes in posture, and so on. At the lower end of the zone the critical temperature is reached. As the chamber temperature is lowered below the critical, step by step, heat loss is more and more increased; and the body maintains its temperature by resort to shivering, so that muscle energy turned into heat causes heat production to keep even with heat loss. This is observed in terms of the rising metabolic rate.

The authors described a conceptual mechanical model, housed in a controlled-temperature chamber, which would have a heat source, thermostatic control, and insulation variable automatically up to a maximum. Up to this limit the model would perform within its thermoneutral zone; heat production and heat loss would be held constant by variation of the insulation. Thereafter, as the test chamber is cooled further, heat loss would rise, and the thermostat would operate to make the heat production rise with the loss. The animals are then interpreted in terms of such a model.

The model would have only simple insulation in the true or technical sense; whereas, for the animals insulation "means the sum total of all factors, such as fur, skin and tissue cool-

ing, and posture, that impede the loss of heat from the animal" (p. 249). The reader of this paper may seriously misinterpret its findings unless he carefully takes note of this broadened use of the term *insulation*. Also, it is regrettable that this term, which is needed for what it heretofore has meant, should be so broadly construed. Some other term or phrase, such as *heat conserving ability*, should have been used to denote the over-all effect of the several factors.

The tropical animals display much greater temperature sensitivity than the arctic animals. As the test chamber temperature is progressively lowered, they reach their critical temperatures much sooner, and their metabolic rates thereafter rise much faster than those of the arctic animals. The difference is not accounted for solely by difference in thickness or quality of the fur or feathers. As is brought out, much of the difference in sensitivity comes from differences in adaptive heat regulation factors displayed by the extended parts of the body—the face, limbs and feet. The tropical animal has not had to meet extended cold threats; and when so exposed, the extended parts tend to maintain their temperatures. The arctic animal has had to adapt in order to live through what we tend to consider intense cold exposure; and a major factor of adaptation is its ability to let limbs and feet get along with little heat supplied from the central body mass, accompanied by the fact that normal (and presumably perfectly comfortable) tissue temperatures in the extended parts may be down near 0°. This was demonstrated for the aquatics, and presumably holds for the terrestrials.

Nothing about research is more typical than its tendency to indicate still more research. Plenty of interesting work remains to be done to round out the picture and lend verification. Using thermocouples, the same arctic and tropical species should be studied, to measure skin temperatures and even internal temperatures at various depths, for the extended parts and for the trunk as well. In fact, a little of this work was done at Point Barrow.

It is very interesting to note that Point Barrow failed to furnish weather cold enough to cool the test chamber down to the critical temperature for the foxes and dogs. Two foxes were flown to the Naval Research Laboratory in Washington, D.C., where shivering was induced by −70° chamber temperature.

In discussing the ability of arctic mammals to stand cold extremes, the authors would have done well to mention the fact that the insulating quality of entrapped air materially improves with the low temperatures encountered by these animals. Taking the thermal conductivity of air at 40° as a base, the conductivity at −40° is about 80% as great; and at −70°, about 70%. This must be of real importance in arctic survival.

The third paper opens by contrasting the extremes of the thermal environment of Point Barrow with the relatively constant environment at Barro Colorado. Body temperature and climatic adaptation are then discussed, and it is shown that with few exceptions—all moderate in degree—mammals and birds the world over have body temperatures falling within a narrow temperature band. That is, the homoiothermic animal, broadly speaking, does not adapt to climate by change of body temperature. Insulation and climatic adaptation are taken up next; and here, of course, it is brought out that change in amount of insulation is a major adaptive factor. Also, if we follow the authors when they include, under the term insulation, vasomotor regulation permitting body extremities to drop in temperature, then it can be said that: "The cold legs of arctic aquatic birds and mammals (and probably of the terrestrial forms as well) may be taken as another example of adaptive insulation" (p. 262).

The paper presents new data on basal metabolic rates, showing them in relation to the standard mouse-to-elephant curve of kg.-calories per day plotted against weight. All of the arctic and tropical mammals fall on or close to the curve, except that the weasel is quite high (two or three times the expected value) and the sloths, with their labile temperatures, are low. The authors apparently accept the arctic weasel as an exception and they point, in this connection, to what they believe to be an insulating coat thin enough to go along with the apparently higher basal rate. "Hence we are forced to conclude that our arctic weasels had a greatly increased

resting metabolic rate compared with the southern form. This may possibly mean a metabolic adjustment to cold" (p. 265). The exception is so striking—as is the conclusion forced upon us if it is proved—that further research on the northern form surely is in order.

The weasel is an extremely active animal. Benedict was meticulously careful to make sure his animals were in a truly resting state before he accepted a metabolic rate as basal. He also found that unless a wild animal became accustomed to test conditions, rates were high even at rest. The weasel is prone to be defiant and restless. In further tests, steps should be taken to make sure that both criteria are met. It may even be necessary to duplicate, on the weasel, Hoover's work on the rat, by killing the animal, quickly measuring metabolic rates for the several main types of tissue, allowing for heart and respiratory activity, and summing up.

New data on birds are also presented. Much less is known about basal rates for birds than for mammals. However, "Two of our night hawks [Pauraques] are very low, and this is probably due to their faculty for hibernation" (p. 265). The two Glaucous Gulls studied were high. But, as is said: "More material is necessary before we can tell whether the basal metabolism in birds may be adaptive to climate" (*loc. cit.*).

The critical temperature, to repeat, is the lower limit of the thermoneutral zone. The difference between this and the body temperature is called "critical temperature gradient" by the authors. For four arctic and seven tropical species, they give the value as observed; and also, as calculated by use of basal rate, body insulation as measured, and surface area as computed by the Meeh formula. In spite of the over-simplification inherent in the calculating method, the agreement between observed and predicted values is surprisingly good in most cases.

The critical temperature *gradient* just mentioned should have been called the critical temperature *difference*. The general excellence of these three papers may tend to induce some workers to adopt all of their usages. However, very strong objection must be entered against the misuse of the term *gradient* which, throughout the papers, is almost always used when *temperature difference* is what is intended.

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THE EXTERNAL PARASITES OF BIRDS: A REVIEW

BY ELIZABETH M. BOYD

Birds may harbor a great variety and number of ectoparasites. Among the insects are biting lice (Mallophaga), fleas (Siphonaptera), and such Diptera as hippoboscid flies (Hippoboscidae) and the very transitory mosquitoes (Culicidae) and black flies (Simuliidae), which are rarely if every caught on animals since they fly off as soon as they have completed their blood-meal. One may also find, in birds' nests, bugs of the hemipterous family Cimicidae, and parasitic dipterous larvae that attack nestlings. Arachnida infesting birds comprise the hard ticks (Ixodidae), soft ticks (Argasidae), and certain mites.

Most ectoparasites are blood-suckers; only the Ischnocera lice and some species of mites subsist on skin components. The distribution of ectoparasites on the host varies with the parasite concerned. Some show no habitat preference while others tend to confine themselves to, or even are restricted to, definite areas on the body. A list of 198 external parasites for 255 species and/or subspecies of birds east of the Mississippi has been compiled by Peters (1936) from files of the Bureau of Entomology and Plant Quarantine between 1928 and 1935. Fleas and dipterous larvae were omitted from this list. According to Peters, it is possible to collect three species of lice, one or two hippoboscids, and several types of mites on a single bird. He records as many as 15 species of ectoparasites each from the Bob-white (*Colinus virginianus*), Song Sparrow (*Melospiza melodia*), and Robin (*Turdus migratorius*). The lice and plumicolous mites, however, are typically the most abundant forms present on avian hosts. A good introduction to this field of investigation is "Medical Entomology" by Matheson (1950).

When collecting ectoparasites, the sooner the bird is examined the better, for the parasites, in particular the mites, are easier to see while they are still alive. If inconvenient to examine the freshly killed bird, it should be wrapped in cotton, placed in a refrigerator, and examined as soon as possible. By then most of the hematophagous ectoparasites will have left the skin, been entrapped by the cotton, and be readily visible thereon. The non-blood-suckers usually remain attached to the skin and feathers. Examination of the specimen should be conducted near a closed window in a strong light and under a binocular microscope. The feathers should be carefully turned back with forceps for inspection. Hippoboscids tend to fly toward the light and will thus be easily captured. The eyes, ears, head, back, legs, tail and wings (in particular the under surface of the remiges and under wing coverts) should be examined systematically. Special attention should be given the ventral body feathers and skin, especially around the vent. The roof of the mouth should be cut so as to expose the turbinals for possible nasicolous mites. The parasites may be removed with fine forceps (mites, with a fine needle previously dipped in alcohol) and preserved in 70% alcohol. Temporary or semipermanent microscopic preparations may be made in PVA-lactic acid medium (Pratt and Lane, 1949), or, if the ectoparasites are delicate and lightly chitinized, in chloral hydrate gum-arabic medium (Doetschman, 1944). Permanent preparations may be made by subjecting the latter to heat, and by soaking the former in water, then proceeding in the usual manner for mounting arthropods.

The Mallophaga (suborders Amblycera and Ischnocera) are obligatory parasites: their life cycle must be spent entirely on the host. Their metamorphosis is incomplete. The forms which parasitize birds lay their eggs on feathers. The author has observed that the eggs of at least ten species (six genera) are distinctive with respect to size, shape, cap pattern, and position and method of attachment. Females probably remain fertile for life (one female was observed to lay fertile eggs for a period of 30 days after her mate had died). In general, the Amblycera possess squat bodies, are quick runners, are usually found between the skin and the quill, and often have red intestines, indicative that blood makes up part of their diet (Boyd, 1951). The Ischnocera have relatively narrow bodies, their intestines are never red,

and they are usually found clinging to their source of food, the feathers themselves. Recent taxonomic studies of lice, particularly those of game birds, have been undertaken by Emerson (1950). The distribution of Mallophaga on the host is often characteristic for each species of louse. Thus on the Common Crow (*Corvus brachyrhynchos*), *Degeeriella rotundata* and *D. secondaria* occur on the flight feathers, while *Myrsidea interrupta* and *Philopterus corvi* are confined to the plumage of the breast (Morgan and Waller, 1941).

The other insects parasitizing birds and also having incomplete metamorphosis are bugs of the order Hemiptera. They resemble their close relative the bedbug in habit, except that they live in birds' nests rather than in human dwellings. Species of bugs have been collected from nests of the Chimney Swift (*Chaetura pelagica*), from nests of certain swallows (Hirundinidae), and from henhouses.

Fleas undergo complete metamorphosis and the larvae are non-parasitic. Since their immature stages are associated also with the homes of the respective hosts, it is not surprising to find fleas in birds' nests. The flea most commonly found thus is *Ceratophyllus gallinae*.

Hippoboscid flies are also obligatory parasites. They die usually within two or three days when removed from the host. Peters lists seven genera parasitizing birds. The three commonest species are *Ornithoica vicina*, *Ornithomyia fringillina* (syn. *O. anchineuria*), and *Lynchia americana*, the first two infesting mainly passerines. *Ornithoica vicina* has been recorded from at least 27 passerines, especially the Song Sparrow, and also from owls, hawks, the Mourning Dove (*Zenaidura macroura*), and Downy Woodpecker (*Dendrocopos pubescens*). Very similar to this species is *O. confluenta* from wading birds. About double the size of *Ornithoica vicina*, and brown to dark green, is *Ornithomyia fringillina*, which has been found on 30 passerines, principally the Cowbird (*Molothrus ater*) and Red-wing (*Agelaius phoeniceus*), and also on the Marsh Hawk (*Circus cyaneus*), Downy Woodpecker, and Bob-white. Herman (1937) states that it is unusual to collect a Cowbird in August that does not harbor at least one *O. fringillina*. Five species of *Lynchia*, all much larger than those of the two previous genera, have been recorded from avian hosts. *L. americana* occurs on eagles, hawks and owls, as well as on the Egret (*Casmerodius albus*) and Ruffed Grouse (*Bonasa umbellus*). Hippoboscids have been collected between April and November, the majority in July and August. They attack more juveniles than adults—89% juveniles and 11% adults in an instance reported by Thompson (1940). The parent fly probably dies after giving birth to its two larvae, which almost immediately pupate. The insects apparently winter-over as puparia in the hosts' nests. (Dr. J. C. Bequaert of Harvard University desires specimens of this family for his collection. The data should include, of course, a careful identification of the host.)

Dipterous larvae that attack nestlings include those of the calliphorid genera *Protocalliphora* and *Apaulina*. The adults are blowflies. They lay their eggs in birds' nests up until the time the nestlings are half grown. Typically, the larvae are nocturnal and feed intermittently, attacking the legs, base of the primary feathers, and rarely the crown or ear cavity. Pletsch (1948) reported that they occur on or in wounds of the body or head and even in the nasal cavity. Species of *Apaulina* have been found on the abdomen and in the ear but also embedded beneath the skin (George and Mitchell, 1948). When ready to pupate they seek a quiet part of the nest or leave it altogether. They probably winter-over as adults.

Ticks (larvae, nymphs and adults) are completely hematophagous and tend to attack the head of the host, especially the eyes. Their egg production is enormous. Most of them are able to winter-over at any stage if unfed; many, such as the fowl tick *Argas persicus*, can survive three to four years without a blood-meal. They may remain on one host or attack two, three, or many hosts throughout their life history. The majority are 'three-host ticks,' e.g., the common rabbit tick, *Haemaphysalis leporis-palustris*. The Argasidae are many-host ticks with bedbug-like habits. A bird may act as host to ticks in larval, nymphal or adult stages. One of the more unusual life cycles is that described by Baerg (1944) for *Ixodes baergi*. This animal lives on nestling Cliff Swallows (*Petrochelidon pyrrhonota*). Since male ticks have been found

still attached to engorged females, mating probably occurs after the female has deserted the host and is on her way to the egg-laying site. The larvae are 'on hand' in the nests when the swallows return in April. For identification of ticks, the reader is referred to the monographic series on New World ticks prepared at the Rocky Mountain Laboratory by Cooley and Kohls (1945). In these and other works, the following forms are reported from birds: *Ixodes* (14 species); *Ornithodorus* (4 species); *Amblyomma* and *Haemaphysalis* (3 species each); *Argas* and *Dermacentor* (2 species each). *Ixodes brunneus* is the commonest, having been collected from at least 64 species of birds.

Parasitic mites vary greatly in habits. Avian mites belong to the superfamilies Parasitoidea, Trombidoidea and Sarcoptoidea. Among the Parasitoidea are numerous forms that live on bird as well as mammalian blood (Strandtmann, 1949). The two commonest bird species are the chicken mite, *Dermanyssus gallinae*, and the northern fowl mite, *Liponyssus sylviarum*. Unlike the former, which is similar to the bedbug in habit, *L. sylviarum* remains on its host most of the time and lays its eggs either on or off the host. The larvae do not feed but molt into the nymph within a day; both the nymph and adult depend on blood and survive less than two weeks off the host, but in laboratory dishes live as long as 60 to 80 days at a temperature of 7° C. The hematophagous mites live on the bird's skin, on the wing, or in the vicinity of the vent, where their eggs are often to be found loosely attached to the calami or skin. Among the Parasitoidea are the Rhinonyssidae, which inhabit the nasal cavities of birds (Crossley, 1950; Strandtmann, 1951).

The Trombidoidea attack many parts of their hosts. The chiggers, larvae of the trombiculids, whose adults are free-living, are blood-suckers and attack the legs of birds and mammals (Wharton, 1947). Other forms spend their entire life among the feathers and on, or even in, the hosts' skin, e.g., *Harpyrynchus*, *Cnemidocoptes* and *Cheyletus* (Baker, 1949; Turk, 1950). Still others are resident in the nasal chambers of birds (Boyd, 1951). The Sarcoptoidea include the true plumicolous mites (Analgesidae and related families). These spend their entire lives in intimate association with the feathers, from which they derive their nourishment. Most forms live on the under surface of the remiges and under wing coverts, but in heavy infestations they spread to the general body plumage. Eggs are laid singly in the interbarb area with the long axis of the egg parallel to the barb. No species characters are discernible in the eggs.

The prevalence of parasitism is dependent on numerous factors including the activity of the host and the degree of host specificity exhibited by the parasites concerned. A heavily infested bird is apt to be a center for dissemination of ectoparasites to other animals. Birds may partly control vermin by means of dust and water baths, by preening, and possibly, as suggested by Groskin (1950), by 'anting.' Through observation and experimentation it has become evident that the bird's beak plays an important role in the control of ectoparasites (Boyd, 1951; Kartman, 1950). Fleas and Mallophaga have been found in the stomach contents of birds. A Starling (*Sturnus vulgaris*) with deformed bill and a Junco (*Junco hyemalis*) with the tip of its upper mandible missing were exceptionally heavily infested with lice. When preening is prevented or inhibited through experimental removal of part of the bill, lice increase enormously. Molting influences the abundance of ectoparasites in birds. A decline of vermin observed on Starlings in July and August coincided with their molt. Similarly, in ducks, a before-molt 100% infestation by the feather mite *Freyana anatina* dropped to 52% after the molt; and the mites on each bird dropped from 500–600 to 100 or less (Ginetzinskaya, 1942).

Temperature may be a factor controlling the incidence of ectoparasitism as well as distribution of the parasites on the host. The temperature of birds varies a few degrees during the day and in different parts of the body, but it may remain relatively uniform throughout the year provided the birds are able to control the amount of food intake as is the case for *Passer domesticus* (Seibert, 1949). On this host the monthly infestation of lice is consistent, but for some species of birds lice and plumicolous mites are less numerous in cold weather. Experiments by the author, using isolated feathers, have proved that low temperature reduces the

longevity of lice, prolongs the incubation period of their eggs, and reduces their viability; on the other hand, a temperature of 7°C. merely lowers the metabolism of mites; the viability of their eggs remains unimpaired. Depending on the circumstances, therefore, lice and mites may winter-over in the egg stage on the host.

The degree of host specificity is slight for most parasitic bugs, fleas, ticks, and blood-sucking mites; that is, avian forms may frequently attack mammals, and mammalian forms, birds. Consequently the host-list for such parasites is usually large and varied. To cite two examples: the hen flea *Ceratophyllus gallinae* has been recorded for many birds as well as the chipmunk (*Tamias striatus*), while the rabbit tick *Haemaphysalis leporis-palustris* has been reported from 46 species of birds. Other avian ectoparasites infest only birds, and some of them infest only those belonging to the same order or family as that of their principal host. Mallophaga display marked host specificity: although the Cowbird is known to come in contact with some 158 species of birds through its egg-laying habit, the eight species of lice collected from numerous Cowbird skins are all typically parasitic upon the Icteridae (Ewing, 1933). In fact, classifications of birds have been based to some extent on a study of their parasites—in particular the Mallophaga and certain mites (Hopkins, 1942). The mite *Eupterolichus bicaudatus* is found only on the African Ostrich (*Struthio camelus*) and South American Rhea (*Rhea americana*).

Bodily contact is of prime importance in transmission of ectoparasites, especially among those with slight host specificity, and the habits of the bird have a marked bearing upon the matter. Parasitism by the tick *Ixodes brunneus* runs higher in migratory than in nonmigratory birds; and the same holds true for most hippoboscids. Similarly, Geist (1935) found louse infestations high on gregarious birds (61%) as compared with non-gregarious forms (41%)—particularly the large land birds (65.1%) as compared with aquatic Ciconiiformes, Anseriformes, Charadriiformes, and Gruiformes (57.7%) and small cuculiform, piciform and passeriform land birds (40.4%). Among passerines, incidence is heaviest in the gregarious Hirundinidae, Corvidae, Sturnidae, and Icteridae, and in the non-gregarious Laniidae and Vireonidae. The brooding of young and the roosting side by side of adults must certainly aid dissemination of parasites. This accounts for the interchange of parasites between the Starling and certain native American birds: the louse *Degeeriella nebulosa* on *Turdus migratorius*, the mite *Speleognathus sturni* on the Great-tailed Grackle (*Cassidix mexicanus*), and the icterid louse *Degeeriella illustris* on the Starling (Boyd, 1951). Predators and ground-feeding animals help in spreading numerous ticks and other ectoparasites. The Cooper's Hawk (*Accipiter cooperi*), Bob-white and other birds may, along with the horse, dog, cat, fox and many rodents, harbor the flea *Echidnophaga gallinacea*. Similarly may the presence on the Marsh Hawk of *Ornithomyia fringillina*, a hippoboscid ordinarily found on passerines, be accounted for.

Dispersal of parasites is probably at its peak during the nesting season. Ectoparasites tend to desert parent birds and to attack nestlings, and some are left in the nest when the young birds fledge. Position and type of nest play a part in the degree of parasitism. Low nests of the Cliff Swallow appear to be more susceptible to attack by the tick *Ixodes baergi* than high ones (Baerg, 1944). Mud-constructed nests and nests in holes are favorable abodes for parasitic bugs, fleas, hippoboscid flies and *Protocalliphora*, for the life cycle of these may be passed within the nest itself. The single finding of *Ornithomyia fringillina* on an adult Black-capped Chickadee (*Parus atricapillus*) was correlated with the parasitic nesting habit of the Cowbird, for this hippoboscid was collected also from two young Cowbirds in this particular chickadee's nest (Herman, 1937). The usurping of nesting-holes accounts for much interchange of ectoparasites. *Ceratophyllus fringillae*, a flea of the English Sparrow (*Passer domesticus*), has been found in nests of the House Martin (*Delichon urbica*) and Barn Swallow (*Hirundo rustica*). The hen flea *C. gallinae* has been collected from nests of the House Martin, Barn Swallow, Bluebird (*Sialia sialis*), Tree Swallow (*Iridoprocne bicolor*), and Starling, and also from the chipmunk. Peters reported the hippoboscid *Ornithoica vicina* not only from certain passerines but also from the Screech Owl (*Otus asio*) and Downy Woodpecker. The tick *Ornithodorus*

parkeri has been taken from burrows of rabbits, nests of Burrowing Owls (*Speotyto cunicularia*), and directly from mice, as well as from man. Among the mites, *Atricholaelaps megaventralis* has been found on foxes, squirrels, many woodpeckers, the Starling and English Sparrow, and in nests of the Cliff Swallow.

Hippoboscids are believed by Herman to be unimportant as disseminators of Mallophaga, though such dissemination has been reported repeatedly. Other factors determining host-parasite relationships are the mechanical limitations of the host and the availability of food provided by the host. Eichler (1939–40) demonstrated that the presence of certain lice and mites may depend upon the dimensions of the various components of feathers and hair. A certain louse has been successfully reared on isolated feathers of its own host, but not on feathers from a different species of bird.

Serious harm may be inflicted on animals by infestations of ectoparasites. Their irritating presence produces a rundown condition in the host, lowering its resistance to disease, and skin lacerations caused by them may act as portals of entry for bacteria. In poultry and other birds parasites may decrease egg-production. Deplumation may result from presence of itch mites (e.g., *Syringophilus bi-pectinatus* and *Microlichus avus*), blood-sucking mites (*Dermanyssus gallinae* and *Liponyssus sylviarum*) and other vermin. Tumor formation around feather follicles may result from attacks of *Harpyrynchus* mites, and a condition of 'scaly leg' on legs and bill from attacks by six species of *Cnemidocoptes* (Turk, 1950). The host has been known to die in the act of swallowing, suffocated through pressure on the windpipe by a dipterous larva (*Apaulina hirundo*) buried in the dermis of the neck (George and Mitchell, 1948).

Animals may suffer seriously from anemia as a result of haematophagous parasites. Anemia in birds may be caused by ticks, blood-sucking mites, Mallophaga, fleas, hippoboscid flies, or dipterous larvae. Death of fledglings from infestations of *Protocalliphora* has been reported repeatedly. A Great Horned Owl (*Bubo virginianus*), believed to have been too weak to hunt normal prey because of a heavy infestation of over 100 hippoboscids, attacked domestic turkeys. The tick *Ixodes brunneus* may be so voracious that the avian host becomes unable to fly and even dies. Webster (1944: 612) reported that 65% of young Prairie Falcons (*Falco mexicanus*) starved during their first month through weakness from tick attacks. Williams (1947) reported young raptors so heavily infested by *Ornithodorus aquilae* that their eyes were almost closed. *Ixodes baergi* appears to cause only slight damage to nestling Cliff Swallows, though as many as 18 have been taken from a single bird (Baerg, 1944). Baerg observed, however, that nestling Starlings reared in holes previously occupied that same year were heavily infested with mites.

Many disease-producing organisms are dependent on arthropods for transmission. Mosquitoes of the tribe Culicini are intermediate hosts for bird malaria, and experimentally *Anopheles* is also. Mosquitoes may transmit trypanosome protozoa and filarial nematode worms. The latter may be dependent on mites, since mites are the vectors for the *Filaria* of the cotton rat (*Sigmodon*). Certain species of hippoboscid and simuliid flies probably act as intermediate hosts for *Haemoproteus* and leucocytozoon protozoa respectively. Ticks such as *Argas persicus* and the mites *Liponyssus sylviarum* and *Dermanyssus gallinae* are known to transmit the spirochaete *Treponema gallinum*. This causes relapsing fever, fowlpox, or spirochaetosis. Mites may also transmit the bird protozoa, *Hepatozoon* and *Toxoplasma*, and the cholera-producing bacterium *Pasteurella*. Toxoplasmosis of birds may be identical to that of mammals. Tularemia is a bacteria-produced disease affecting rabbits and other warm-blooded animals including birds and man. Several species of ticks constitute the primary vectors of this bacterium. Of these, four genera, *Dermacentor*, *Amblyomma*, *Ixodes* and *Haemaphysalis*, have been collected from birds.

Some avian ectoparasites with slight host specificity have been known to attack man. Various bugs at times desert birds' nests and invade human dwellings. The chicken mite and northern fowl mite may cause dermatitis in human beings. Some ectoparasites that are carriers

for disease-producing organisms in humans may attack avian hosts. Birds may harbor the immature stages of ticks responsible, as vectors, for Rocky Mountain spotted fever, Bullis fever and relapsing fever. The reservoir for Tsutsugamushi disease, common in certain parts of the world, may be increased through avian mites, while the virus for equine and St. Louis encephalomyelitis has been isolated from the chicken and northern fowl mites. Bacterial plague may be spread through infected fleas attacking vultures as they devour their prey. In this manner, birds, on occasion, may indirectly aid in the prevalence of certain human diseases through increasing the animal reservoir of the particular micro-organism involved.

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ZOOLOGY DEPARTMENT, MOUNT HOLYOKE COLLEGE, SOUTH HADLEY, MASSACHUSETTS

Report of Treasurer for 1950

Balance as shown by last report, dated December 31, 1949		$ 244.04
Receipts		
Dues:		
Associate	1,464.50	
Active	2,033.00	
Sustaining	770.00	
Subscriptions to "The Wilson Bulletin"	217.95	
Sale of back issues and reprints of "The Wilson Bulletin"	552.90	
Interest on bonds	155.36	
Transferred from Endowment Fund (Special Fund, interest, etc.)	34.43	
Contributions to Library Book Fund	20.54	
Gifts; miscellaneous	306.68	
Total receipts		$5,799.40
Disbursements		
"The Wilson Bulletin"—printing, engraving, mailing	$3,265.92	
Purchase of back issues of "The Wilson Bulletin"	99.30	
President's expense—printing, postage	19.53	
Editor's expense—reprints, postage, secretarial aid	156.09	
Secretary's expense—stationery, postage, clerical aid	102.20	
Treasurer's expense—stationery, postage, clerical aid	285.49	
Membership Committee expense—postage, printing	186.15	
Endowment Committee expense—postage, printing	2.40	
Dues to International Committee for Bird Preservation	10.00	
Annual Meeting expense	108.15	
Bank charges, foreign exchange, corporation papers, and miscellaneous expenses	3.30	
Total disbursements		$4,238.53
Balance on hand in The Worthington Savings Bank, Worthington, Ohio, December 31, 1950		1,560.87
		$5,799.40

Endowment Fund

Cash balance in Savings Account December 31, 1949		$ 637.72
Received during year:		
Interest on U. S. Bonds and on Savings Account	$ 155.36	
Life Membership Payments	750.00	
		905.36
		$1,543.08

Disbursed during year:

Purchase of U. S. Savings Bonds—Series "F", dated April 1, 1950.	$ 740.00	
Transferred to checking account (Special Fund, interest, etc.)	34.43	
Louis Agassiz Fuertes Research Grant payment	100.00	874.43
Balance Cash in Savings Account December 31, 1950		$ 668.65

*Securities Owned:**

U. S. Postal Savings Coupon Bonds, dated July 1, 1935	$ 780.00	
U. S. Savings Bonds, Series "G", dated September 1, 1943 (maturity value $1,000.00)	961.00	
U. S. Savings Bonds, Series "G", dated September 20, 1944 (maturity value $1,500.00)	1,432.50	
U. S. Savings Bonds, Series "G", dated June 1, 1945 (maturity value $500.00)	476.00	
U. S. Savings Bonds, Series "G", dated July 1, 1945 (maturity value $900.00)	856.80	
U. S. Savings Bonds, Series "G", dated October 1, 1945 (maturity value $1,400.00)	1,328.60	
U. S. Savings Bonds, Series "F", dated February 1, 1947 (maturity value $2,000.00)	1,534.00	
U. S. Savings Bonds, Series "F", dated April 1, 1948 (maturity value $2,000.00)	1,508.00	
U. S. Savings Bonds, Series "F", dated October 1, 1948 (maturity value $1,450.00)	1,086.04	
U. S. Savings Bonds, Series "F", dated April 1, 1950 (maturity value $1,000.00)	740.00	
Total, securities owned*		$10,702.94
Total Endowment Fund		$11,371.59

* Bonds carried at redeemable value December 31, 1950.

In reserve:

Louis Agassiz Fuertes Research Grant Fund (special gift)	$ 225.00	
S. Morris Pell Fund (special gift)	75.00	

Respectfully submitted,
JAMES H. OLSEN, *Treasurer*

December 31, 1950
Approved by Auditing Committee:
LEONARD C. BRECHER
BURT L. MONROE
R. ALLYN MOSER

Announcement of Annual Meeting

Note: This is the official announcement of the annual meeting. No individual letters of announcement will be mailed, but, as in the past, the completed program will be sent to members a short time in advance of the meeting.

Place and time. The Thirty-third Annual Meeting of The Wilson Ornithological Club will be held in Gatlinburg, Tennessee, Friday and Saturday, April 25–26, 1952. Headquarters will be at the new Greystone Playhouse, adjacent to the Greystone Hotel in Gatlinburg. On Thursday evening the Executive Council will meet. On Sunday, April 27, there will be organized field trips.

Gatlinburg and how to reach it. Gatlinburg is on the northern border of the Great Smoky Mountains National Park. For those driving to the meeting, it may be reached by highways from Sevierville or Maryville, Tenn., or Cherokee, N. C. By bus it may be reached via Knoxville, Tenn., or Asheville, N. C. The nearest train and plane terminal is Knoxville, from which Gatlinburg may be reached by the Trailways Bus Company.

Gatlinburg is primarily a tourist town, serving visitors to the Great Smoky Mountains National Park. It is famous as a center of mountain crafts and hand industries.

The Greystone Playhouse. All sessions will be held in this new auditorium, site of the 1951 Governors' Conference.

Sessions. Sessions will be held on Friday and Saturday. Because of the exceptional attractions of the area, morning sessions will not begin until 10:30 to permit short field trips each day.

Special Events. On Friday evening there will be a short program at the Playhouse, followed by an informal get-together.

At 4:30 on Saturday afternoon there will be a demonstration of pottery making by Douglas Ferguson at the Pigeon Forge Pottery. This will be held at the Mountain View Hotel, and will be accompanied by a display of mountain crafts.

The Annual Dinner will be held in the Greystone Playhouse at 8 o'clock Saturday evening. It will be served buffet style by the Greystone Hotel, well known in this region for its good food. This will be followed by entertainment and the President's address.

Meeting of the Council. The meeting of the Executive Council will be held at 7:30 p.m., Thursday, April 24, at the Greystone. The secretary requests that the chairmen of the standing committees send their written reports to him by April 15 so that these may be discussed by the Council. Chairmen are invited to present their reports in person at the Council Meeting.

Accommodations. The Gatlinburg Chamber of Commerce will send out to the Wilson Club membership by early April a folder describing the accommodations available. This will be accompanied by a folder describing the Great Smoky Mountains National Park and its camping facilities. All hotels are

within easy walking distance of The Greystone Playhouse, as are the following tourist courts: Bearskin Cottages, Conner's Motel, Cooper Court, Edgepark Motel, French Village Cottages, Huff's Tourist Court, Laurel Springs Cabins, Park Tourist Court, Rocky Waters Court, Zoder's Court. All members are urged to write directly to the hotel or tourist court for reservations.

Field Trips. On Sunday there will be field trips to two general regions, one to the high-altitude spruce-fir forest in the vicinity of Newfound Gap and one to the low altitudes of Cade's Cove and the Giant Forest. On Friday evening, weather permitting, there will be a special trip to Newfound Gap and beyond for the chance of hearing the Saw-whet Owl's song. There will be a short field trip in the vicinity of Gatlinburg early Saturday morning.

Hosts. The host organizations for this meeting are the Tennessee Ornithological Society, the Carolina Bird Club, and the Georgia Ornithological Society. The chairman of the local committee is Arthur Stupka, Gatlinburg.

Application for a Position on the Program

Members who have not yet published on their research, or who have motion pictures or slides of special interest, are urged to apply for a place on the program. Papers will be selected for their timely interest and their contribution to ornithology. In selecting papers, the Secretary will be assisted by the Local Committee and by other officers of the Club. Members who have nothing themselves to present may be able to suggest outstanding papers which the Secretary can secure for this meeting.

If you would like to appear on the program at Gatlinburg, please write to the Secretary, Harold F. Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio, not later than March 1, 1951. Please note that no more than one paper may be presented by any one member. A paper accompanied by motion pictures must not exceed 30 minutes. A paper accompanied by slides must not exceed 20 minutes. A paper without pictures must not exceed 15 minutes. A limited time for discussion will follow each paper.

In writing the Secretary, please supply *all* of the following information:

1. *Title of paper.* Give the title exactly as you want it to appear on the program.

2. *Abstract.* Prepare an abstract of your paper—brief, but sufficiently complete so that it may be used by the Local Committee for publicity and by the Secretary in preparing the meeting's proceedings.

3. *Time required.*

4. *Position.* State if it is essential that you appear at a particular time.

5. *Special equipment needed.* Blackboard, map hanger, pointer, etc.

6. *Motion pictures.* If your paper is to be illustrated with motion pictures give the following information: Size (16 mm. or 35 mm.). Color or black-and-white. Total footage. Number of reels. Size of reels.

7. *Slides.* If your paper is to be illustrated with slides, give the following information: Size ($3\frac{1}{4}''$ x $4''$, or $2''$ x $2''$). Color or black-and-white. Number of slides.

8. *Name.* Please write your name exactly as you wish it to appear on the program. Titles before names will not be used.

9. *Address.* Include the name of the institution with which you are associated, if any. The name of this institution will appear after your name on the program.

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SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Use figures for all definite weights, measurements, percentages and degrees of temperature (for example: 2 kgm., 1 inch, 20.5 cc., 300°C.). Spell out indefinite and approximate periods of time and numerals used in a general manner (for example: one hundred years ago; about two and one-half hours; seven times). Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A.O.U. Check-list (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Follow carefully the style used in this issue in listing, after the paper, the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Club loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly.

NOTICE OF CHANGE OF ADDRESS

If your address changes, notify the Club immediately. Send your complete new address to the Treasurer, Leonard C. Brecher, 1900 Spring Drive, Louisville 5, Kentucky. He in turn will notify the publisher and editor.

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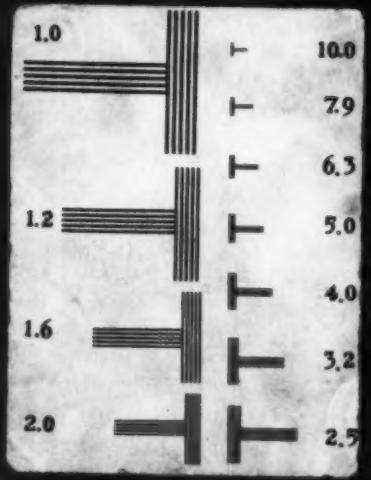
THIRTY THIRD ANNUAL MEETING

GATLINBURG, TENNESSEE, APRIL 25–26, 1952

In order to give members more time in the field, morning papers sessions will begin at 10:30 o'clock. The Great Smokies will be beautiful in late April. Every member should plan to attend. Complete details in this issue.

RESOLUTION CHART



100 MILLIMETERS

INSTRUCTIONS Resolution is expressed in terms of the lines per millimeter recorded by a particular film under specified conditions. Numerals in chart indicate the number of lines per millimeter in adjacent "T-shaped" groupings.

In microfilming, it is necessary to determine the reduction ratio and multiply the number of lines in the chart by this value to find the number of lines recorded by the film. As an aid in determining the reduction ratio, the line above is 100 millimeters in length. Measuring this line in the film image and dividing the length into 100 gives the reduction ratio. Example: the line is 20 mm. long in the film image, and 100/20 = 5.

Examine "T-shaped" line groupings in the film with microscope, and note the number adjacent to finest lines recorded sharply and distinctly. Multiply this number by the reduction factor to obtain resolving power in lines per millimeter. Example: 7.9 group of lines is clearly recorded while lines in the 10.0 group are not distinctly separated. Reduction ratio is 5, and 7.9 x 5 = 39.5 lines per millimeter recorded satisfactorily. 10.0 x 5 = 50 lines per millimeter which are not recorded satisfactorily. Under the particular conditions, maximum resolution is between 39.5 and 50 lines per millimeter.

Resolution, as measured on the film, is a test of the entire photographic system, including lens, exposure, processing, and other factors. These rarely utilize maximum resolution of the film. Vibrations during exposure, lack of critical focus, and exposures yielding very dense negatives are to be avoided.

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